

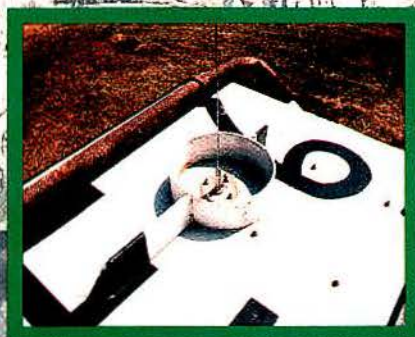
May 1993/\$3.00

Mobile Radio Technology™

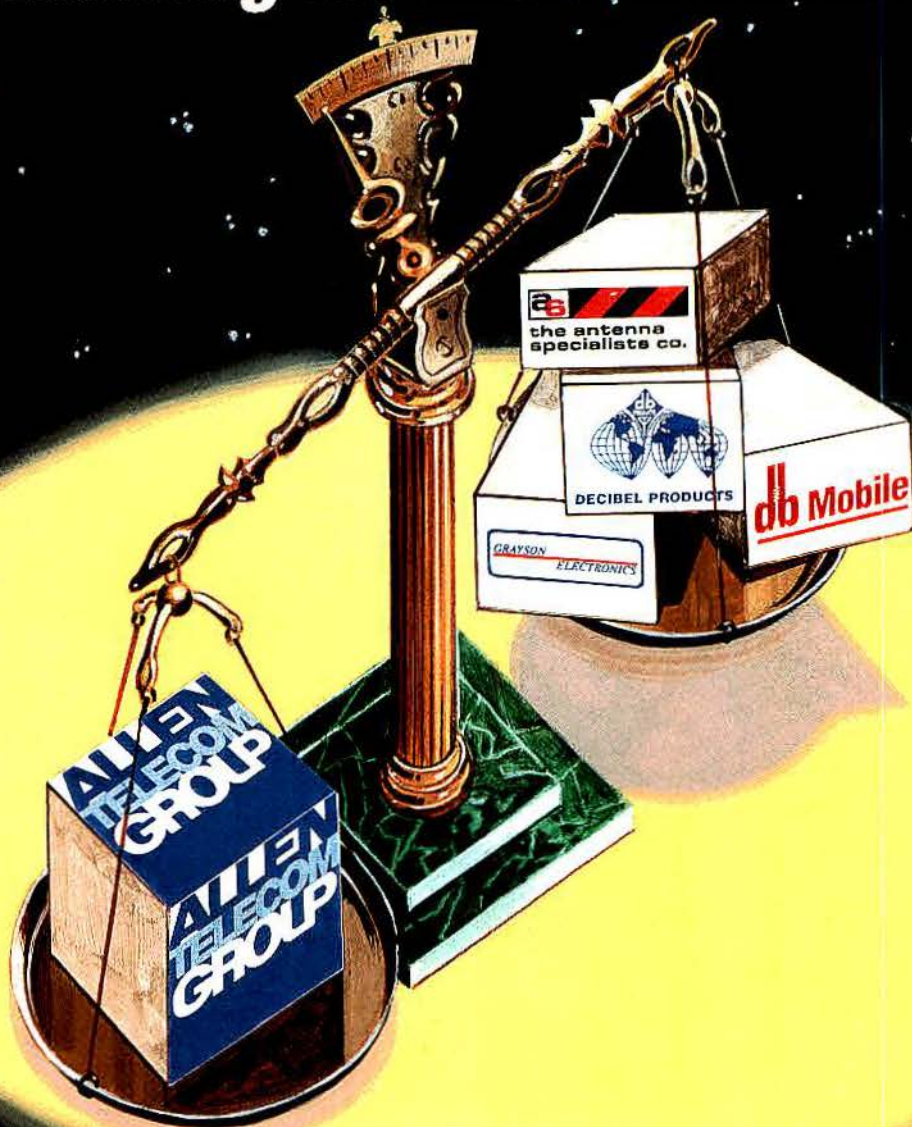
The journal of mobile communications technology

Custom-made mobile antenna, p. 10

Choosing oscilloscopes
RF power measurement tips
Caring for NiCd batteries



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features

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Harold Kinley, CET

Tree limbs used to break antennas off the cabs of forest fire-suppression crawler tractors until a custom mount and protective guard ring were developed.

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Mike Hoyer

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28 Time-saving tips for RF power measurement

E. Kirk Ellis

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36 Taking care of NiCd batteries for portable transceivers

Isidor Buchmann

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On the cover: Harold Kinley operates a South Carolina Forestry Commission fire-suppression crawler tractor fitted with a custom mobile antenna. Inset photos show details of the antenna and radio installation. See his article on page 10.

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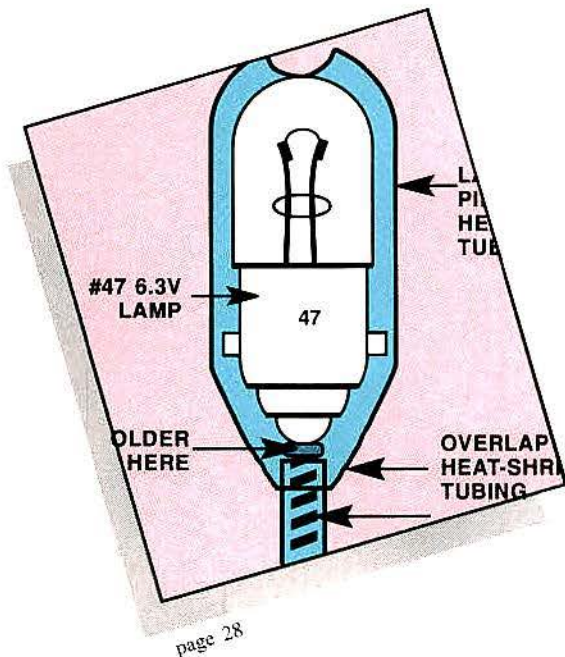
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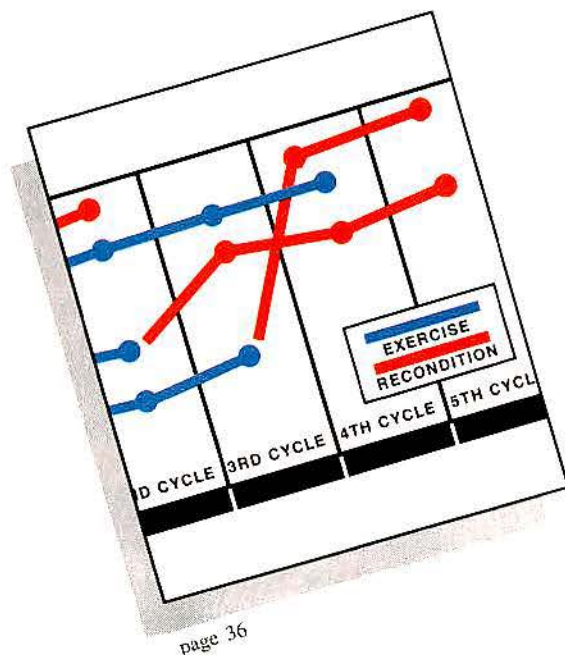
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89 What do you think?

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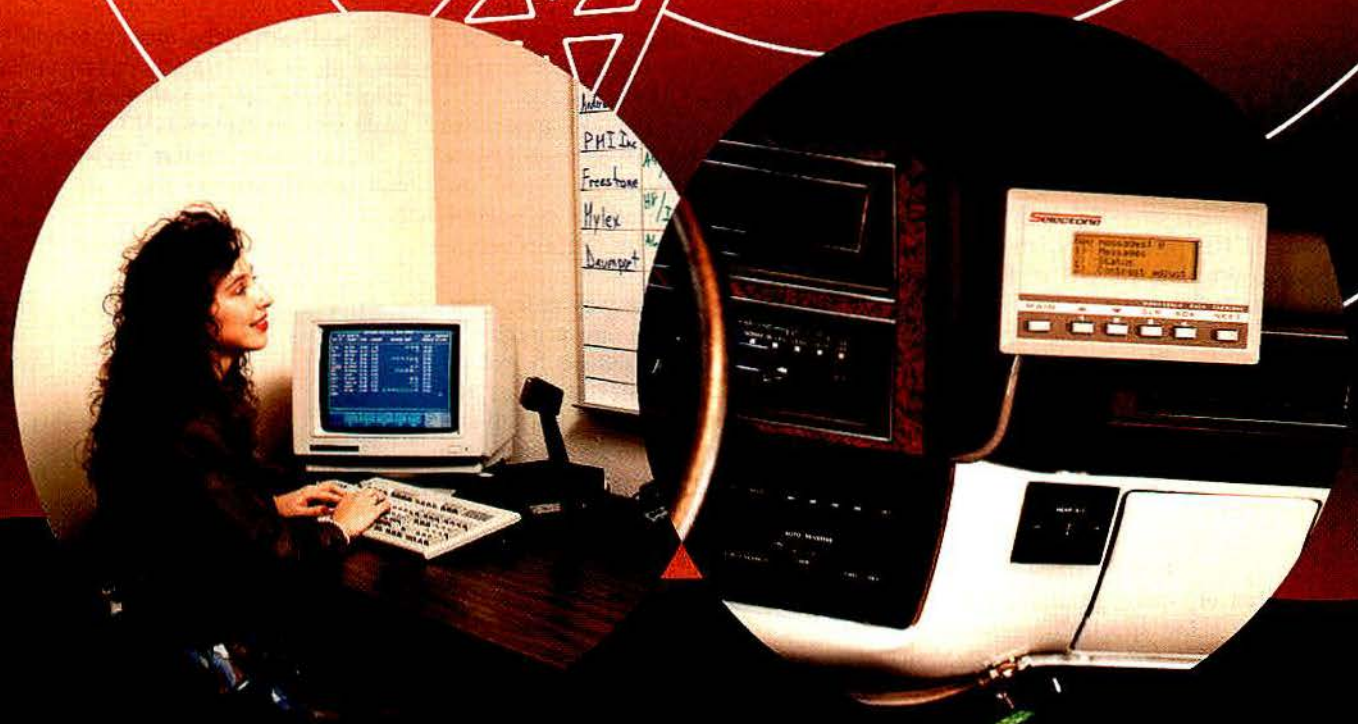


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Perspectives on Part 88



The good news is, everyone has an answer to Part 88.

The bad news is, everyone's answer is different.

The FCC proposal to reform VHF and UHF private land mobile radio spectrum, known as Part 88, has become a real money issue.

Spectrum efficiency

Reforming means to change either the frequency assignments, technical requirements, operating limitations, license eligibility criteria or a combination to put more users into a given amount of radio spectrum than currently is possible.

This objective, putting more users in the same spectrum, generally is called *spectrum efficiency*. Many people, but not all, think that the highest possible spectrum efficiency is the most desirable outcome for any spectrum use plan.

For all but the largest organizations with hundreds or thousands of radio users that can achieve spectrum efficiency within their own systems, spectrum efficiency means sharing radio systems that offer public access, such as specialized mobile radio (SMR) and other networks.

Along the way, new systems with greater spectrum efficiency are expected to offer more operating features and less—or at least no greater—interference among users than present systems offer.

Part 88 is the name given to the section of FCC regulations that would contain the spectrum reforming regulations, as well as the rest of the private land mobile radio regulations.

Follow the money

It will take a lot of money to implement spectrum reforming, money that will flow from businesses and taxpayers.

The money will flow to the federal government for license fees; trade associations for frequency coordination; attorneys for help with FCC matters; consultants for technical and other assistance; manufacturers for new equipment and modification kits; and service providers for access to their communications networks.

The reforming proposal appears to favor the replacement of small private radio systems (systems owned and used by single businesses or government agencies) with public access networks.

This change in the way radio communications services are provided at VHF and UHF may reduce the role of the equipment dealer. One of the dealer's functions has been to sell and maintain private radio systems and the mobile and portable units that go with them.

Radio users who become customers of public access networks may do less business with dealers. Unfortunately, it may cost them more to use public access networks because of recurring airtime charges. With a private system, airtime is "free," once the equipment has been purchased.

Some users and some dealers with parallel interests have organized to oppose much of Part 88, once again because of the money involved.

Technical issues

Political considerations will make the difference when decisions are made about Part 88.

Technical issues are not likely to receive the attention that they might if so much money were not involved.

For example, although Part 88 proposes to reduce transmitter power, *additional* power might actually be

required to support some of the more complex digital modulation methods successfully.

Although Part 88 proposes to reduce channel spacing and transmitter deviation in the name of spectrum efficiency, *wider* channels might actually allow more users to share a given bandwidth using multiple-access technology.

End results

We've been receiving a lot of opinions and questions about the outcome of spectrum reforming.

No one knows what the outcome will be.

Nevertheless, the *money* seems to favor the *large*: large users, large trade associations, large manufacturers and large service providers.

Small private system operators and equipment dealers have an uphill battle.

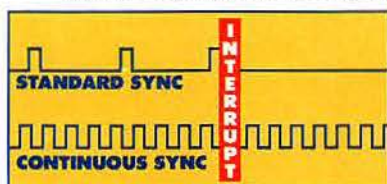
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May

- 12-14—Mobile Communications Conference**, sponsored by the National Association of Business and Educational Radio (NABER), Hyatt Regency Hotel, San Antonio. Contact: 800-759-0300.
- 16-19—East Coast Regional Conference Associated Public-Safety Communications Officers Meeting**, Cavalier Hotel, Virginia Beach, VA. Contact: Bill Marriott, 804-247-8431.
- 18-20—Vehicular Technology Conference**, sponsored by IEEE Vehicular Technology Society, Meadowlands Hilton, Secaucus, NJ. Contact: Mel Lewis, Loral Electronics, 914-968-2500, ext. 2304.
- 26-28—RadioComm**, Metro Toronto Convention Centre, Toronto. Contact: Lisa La Prairie, 613-233-4888.

June

- 29-July 1—Utilities Telecommunications Council Annual Meeting**, San Antonio Marriott Rivercenter and Convention Center, San Antonio. Contact: Rita Clark, 301-621-7802.

July

- 18-22—Forestry-Conservation Communications Association**, Jackson, WY. Contact: Don Pfohl, 602-644-3166.
- 24-28—International Municipal Signal Association**, Norfolk, VA. Contact: Harold Glerum, 800-723-4672.

August

- 8-13—Associated Public-Safety Communications Officers 59th National Conference**, New Orleans Convention Center, New Orleans. Contact: 800-824-1850.

September

- 21-23—International Mobile Communications Expo/Fall**, Philadelphia Convention Center, Philadelphia. Contact: 303-220-0600.
- 28-Oct. 1—Mobile Communications Marketplace**, New Orleans Convention Center, New Orleans. Contact: Telocator, 800-326-8638.

October

- 12-13—SMR/Private Carrier Management Conference**, Loews Coronado Hotel, San Diego, CA. Contact: 202-331-7773.
- 16-21—International Association of Chiefs of Police Annual Conference**, Cervantes Convention Center, St. Louis, MO. Contact: 703-836-6767.

November

- 4-6—Industrial Telecommunications Association Annual Meeting**, La Quinta Hotel, La Quinta, CA. Contact: Barbara J. Levermann, 703-528-5115.
- 11-14—Communications Marketing Conference**, Holiday Inn Riverwalk, San Antonio. Contact: Gene Johnson, Vega Signaling, 818-442-0782.
- 19—Radio Club of America Awards Banquet**, New York Athletic Club, New York. Contact: 201-652-6811.

1994

February

- 7-8—AMTEX**, the American Mobile Telecommunications Association's Marketing and Technology Conference and Exposition, Marriott on International Drive, Orlando. Contact: 202-331-7773.

March

- 2-4—Cellular Telecommunications Industry Association Winter Meeting and Exposition**, San Diego. Contact: 202-785-0081.
- 6-9—Energy Telecommunications and Electrical Association**, Henry B. Gonzales Convention Center, San Antonio. Contact: 214-235-0655.

April

- 13-15—International Mobile Communications Expo/Spring**, Las Vegas Convention Center, Las Vegas. Contact: 303-220-0600.



Mobile Radio Technology

The journal of mobile communications technology

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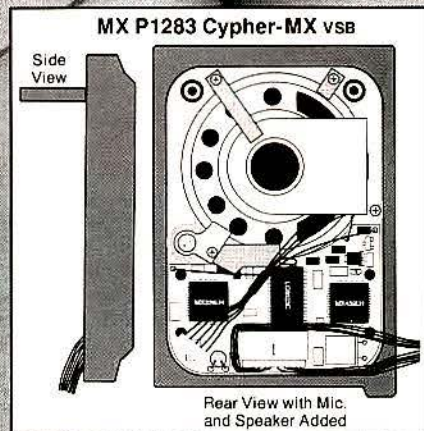
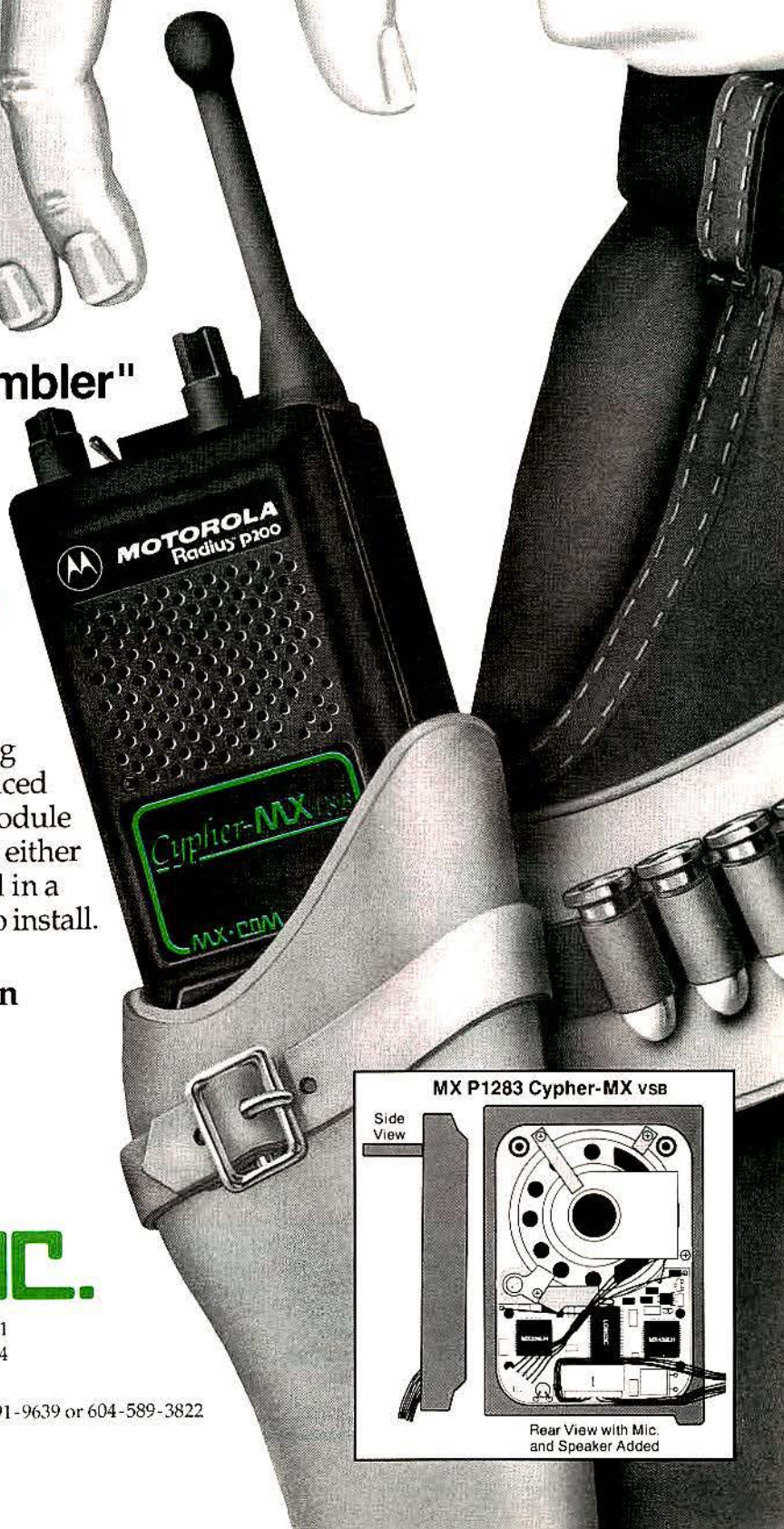
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Co-channel interference: How bad is it?

By Harold Kinley, CET

With the overcrowded land mobile radio frequency spectrum, interference has become the rule, rather than the exception.

Years ago, it was common for land mobile radio users to operate strictly carrier squelch. Although some users still get by with carrier squelch systems, their numbers are dwindling rapidly, and the time is fast approaching when it will be virtually impossible to operate without some kind of coded squelch system, digital or tone.

Classes of interference

Basically, interference can be clas-

sified as either of two types, *nuisance* or *destructive*.

Nuisance interference is heard in the absence of desired signals, but it does not significantly degrade the desired signal.

Destructive interference causes serious degradation to or even blocks the desired signal.

Although a coded squelch system does alleviate most of the *nuisance* interference problems, it is *not* the great panacea that it is perceived to be by most non-technical, and even some technical, people. It does nothing to alleviate problems caused by destructive types of interference.

Even nuisance interference can become harmful if allowed to go *untreated*. For example, a user who is constantly annoyed by noise or other undesirable signals often will turn down the radio's volume control or adjust the carrier squelch control to the maximum position, thus seriously desensitizing the receiver to even the desired signal transmissions.

At this point, the nuisance interfer-

ence has become harmful. A coded squelch system is the logical solution to this type of interference.

There is not much use in crying to the FCC about nuisance interference *unless* it is caused by an improperly or illegally operating transmitter that you can identify. You will not get much sympathy, especially if you are operating carrier squelch only.

Destructive interference is another matter.

Normally, great care is taken by the duly authorized frequency coordinators to eliminate or greatly reduce the likelihood of interference between two users operating on the same frequency.

In spite of the best efforts to avoid interference between co-channel users, problems often occur. Most of the

(continued on page 46)

Kinley is a certified electronics technician with the South Carolina Forestry Commission, Spartanburg, SC. He is the author of *Standard Radio Communications Manual: With Instrumentation and Testing Techniques*, Prentice-Hall, 1985.

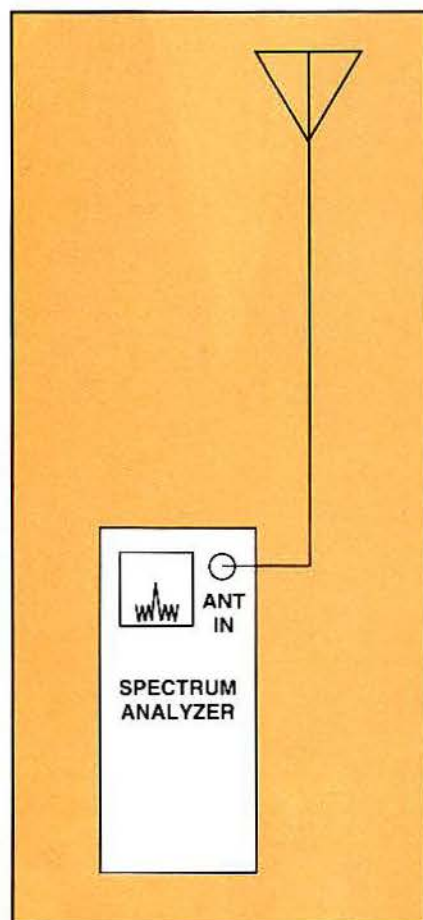


Figure 1. This simple setup can be used to measure the offending interfering signal's amplitude. The spectrum analyzer must be capable of *absolute* (dBm) measurement and not the simple *relative* dB indications on some imitation spectrum analyzers that are a part of some service monitors.

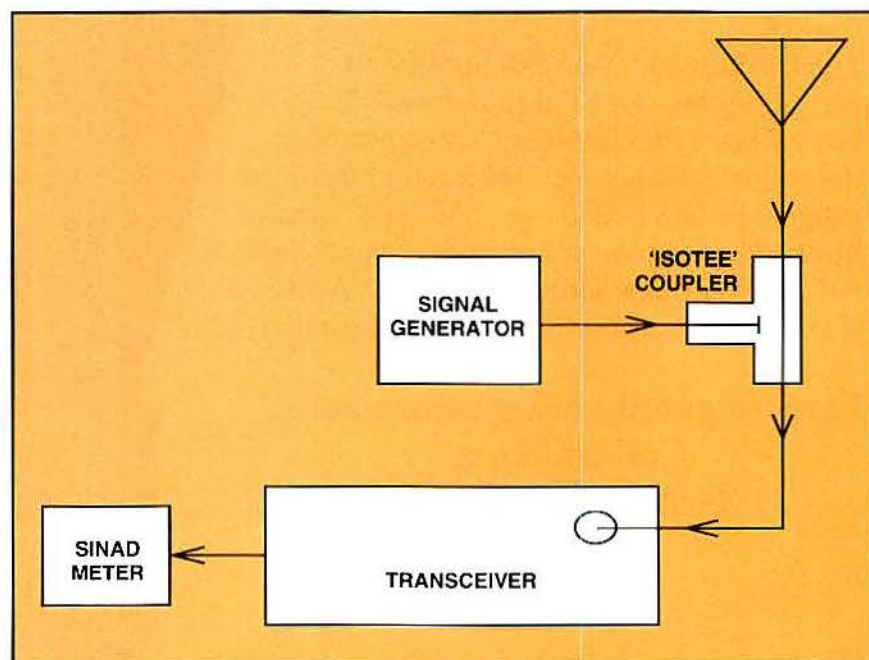


Figure 2. This setup can be used to measure the actual amount of degradation that the interfering signal causes to the desired signal. For example, suppose that in the absence of the interfering signal, a generator output level of -60dBm is required to produce the 12dB SINAD level. Also suppose that in the presence of the interfering signal, the generator output must be increased by 20dB to -40dBm to return the SINAD meter reading to 12dB SINAD . This means that the interfering signal is *degrading* the desired signal by 20dB .

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Tree limbs used to break antennas off the cabs of forest fire-suppression crawler tractors until a custom mount and protective guard ring were developed. Mounting the radios poses challenges, too.



Photo 1. A typical crawler tractor used to suppress forest fires.

By Harold Kinley, CET

Installing radio equipment properly and keeping it working is difficult when it comes to crawler tractors used to suppress forest fires. (See Photo 1 above.)

It is a constant process of evolution in learning the best way to solve problems unique to such installations.

Some of the problems that must be handled are . . .

- Severe vibration (on good terrain).

Kinley is a certified electronics technician with the South Carolina Forestry Commission, Spartanburg, SC. He has written many technical articles on various aspects of radio-electronics. He is the author of *Standard Radio Communications Manual: With Instrumentation and Testing Techniques*, Prentice-Hall, 1985.

- Severe jarring (on rough terrain).
- Tree limbs (all terrain).

The severe vibration can fatigue and break component leads. It can move tuning slugs enough to severely detune the radio—sometimes to the point where the slug actually falls out of the tuning coil. (Candle wax melted into the tuning coil seals the slug into place.)

Newer radios with leadless, surface-mount components are far more rugged and seem to withstand severe vibration and jarring better.

A custom-made box protects the radio set. (See Photo 2 on page 12.) The box mounts underneath the top of the tractor cab.

Wiring to the radio set is kept inside flexible, plastic-coated, waterproof conduit. (See Photo 3 on page 12 and

Photo 4 on page 12.)

Notice the junction box between the loudspeaker and the radio box. This is a regular electrical junction box purchased at a local hardware store.

Connections to the loudspeaker are made within the junction box. Sometimes the junction box contains a headphone jack to allow the tractor operator to plug in a set of headphones.

Battery supply wiring also passes through the junction box down to the battery compartment. The connection to the hot (A+) side of the battery is made on the battery cable away from the battery post.

The hot wire is not connected directly to the battery post because it corrodes so quickly.

The ground wire is not connected to the battery post, either, for two reasons.

The first is the ground wire also corrodes quickly.

The second is the potential for damage to the radio wiring should the ground wire from the battery to the tractor frame open. If that wire opens, then the electrical current flowing from the battery to the starter would pass through the radio wiring.

Obviously, the radio wiring is not heavy enough to carry the heavy current drawn by the starter when it cranks the engine, so part of the radio circuitry and wiring would be burned up. This problem is avoided by grounding the radio away from the battery terminal and away from the point where the battery is grounded to the tractor frame.

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is to keep an antenna mounted on top of the tractor cab intact. Tree limbs easily can break a cab-mounted antenna, rendering the radio useless.

Cast aluminum, low-profile antennas have been used with limited success. These antennas are much more durable than a simple quarterwave whip.

Even so, the cast aluminum anten-

nas broke on a regular basis. Besides, they are more difficult and expensive to replace.

What really forced the antenna mounting situation to be reconsidered was the use of wideband radios. These radios operate across a 151MHz-159MHz band, and the low-profile antennas could not handle the bandwidth.

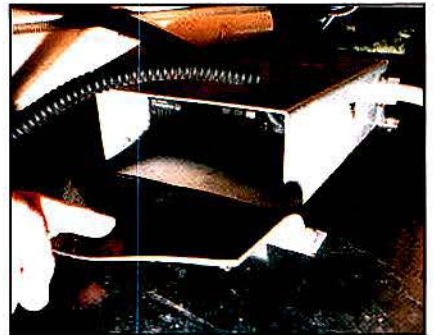


Photo 2. A custom-made radio box with the rubber flap lifted to expose the radio inside.

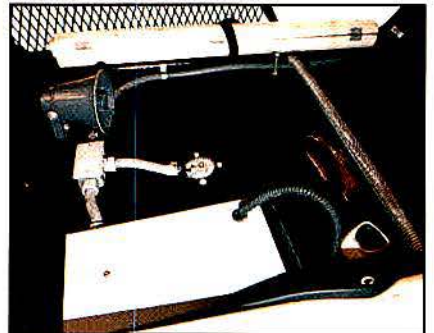


Photo 3. A view of the radio box, junction box and loudspeaker. Notice how all wires and cables are kept inside flexible conduit to minimize damage caused by tree limbs.



Photo 4. Flexible conduit from the battery compartment to the radio box carries supply voltage (A+) to the radio set.

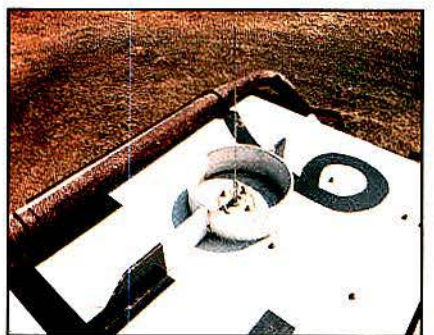


Photo 5. An overhead view of the guard ring, fins and antenna whip with spring.

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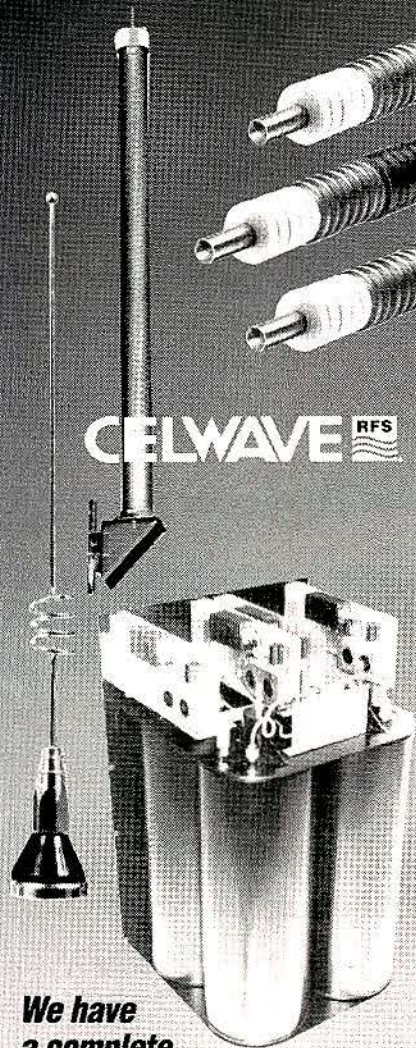
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Photo 6. The front fin of the antenna guard causes a tree limb to ride up to the top of the guard ring.

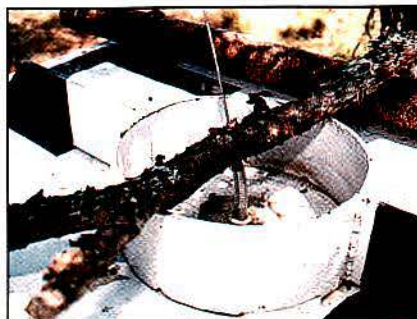


Photo 7. The tree limb makes contact with the antenna whip as the tractor passes under the limb.

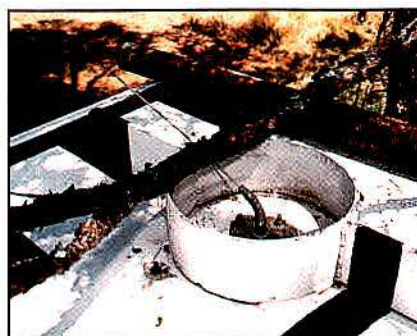


Photo 8. The tree limb passes over the guard ring just above the antenna spring, forcing the antenna whip downward.



Photo 9. The rear fin prevents the tree limb from dropping off the rear of the guard ring suddenly, thus preventing excessive strain to the antenna whip and spring assembly.

At about that time, it was learned that some U.S. Forest Service technicians had been experimenting with a protective ring around a cab-mounted wideband quarterwave whip. Additionally, technicians laid a bar three to four inches wide against the front and back of the ring at an angle and welded it in place. (See Figure 1 on page 16.)

The purpose of this front and back piece is to allow tree limbs to ride gently up to the top of the guard ring instead of hitting it squarely in front or in back.

This basic design was modified as shown in Photo 5 on page 12. Notice that the front and back pieces are different. Instead of placing them flat-side up, they are placed vertically, giving a fin-like appearance.

The leading edge of each fin is cut at an angle to allow limbs to ride up to the top. The guard ring is a 4-inch cross-section of pipe with a 10-inch diameter and a $\frac{3}{8}$ -inch wall thickness.

The fins are approximately 12 inches long (topside) and $\frac{3}{8}$ -inch thick. The guard ring and fins are welded in place on top of the tractor cab. The fins are placed so the top of each fin is approximately $\frac{1}{8}$ -inch above the top of the guard ring.

The purpose of this placement is to allow the antenna whip to fall to either side of the fin as a tree limb passes over, thus alleviating any weight or pressure on the antenna whip.

The operation of this guard ring is shown in the photo sequence to the left. (See Photos 6 through 9.) This photo sequence was taken as a tractor approached and passed directly under a tree limb.

In Photo 6, the front fin caused the tree limb to ride up to the top of the guard ring. In Photo 7, the tree limb has reached the top of the guard ring and makes contact with the antenna whip.

In Photo 8, the limb has forced the antenna whip downward. Because the guard fin is slightly higher than the guard ring, the antenna whip slips off to one side, and the fin takes the weight and pressure of the tree limb away from the antenna whip.

In Photo 9, the rear fin prevents the limb from dropping sharply down off the back of the guard ring as it passes

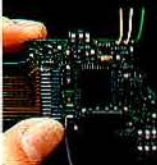
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Photo 10. A view of the antenna base assembly.

over the ring. Otherwise, the limb might sever the whip or place such tremendous pressure on the other antenna assembly components that some part of the antenna might break.

After the limb passes over the rear fin, the antenna spring pops the whip back up. It is hoped that the antenna then still looks the way it did in Photo 5.

Initially, off-the-shelf antenna units were purchased from an antenna manufacturer. After a considerable number



Photo 11. The basic components of the antenna assembly include two Larsen insulators, a spring and a stainless-steel $\frac{5}{16} \times 1\frac{1}{4}$ -inch bolt with a 6-32 screw for connecting the coaxial cable's center conductor.

of antennas were broken, usually at the base, the user custom-designed an antenna base mount that could stand up to more abuse.

After some experiments, it was decided to use the arrangement shown in Photo 10 above. The individual components shown in Photo 10 are shown separated in Photo 11 above.

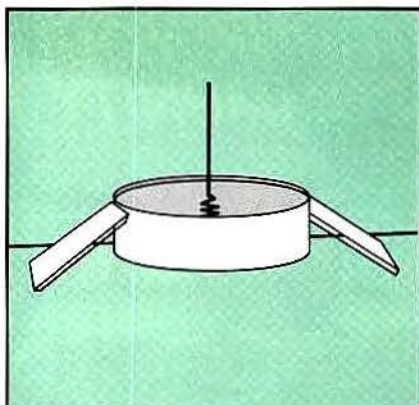


Figure 1. The original design of the antenna guard used on some U.S. Forest Service units.

The base assembly is composed of the following parts:

- ▶ two Larsen insulators.
- ▶ a stainless-steel spring.
- ▶ a $\frac{5}{16} \times 1\frac{1}{4}$ -inch stainless-steel bolt.

The stainless-steel bolt is drilled and tapped for a 6-32 screw to connect the coaxial cable's center conductor.

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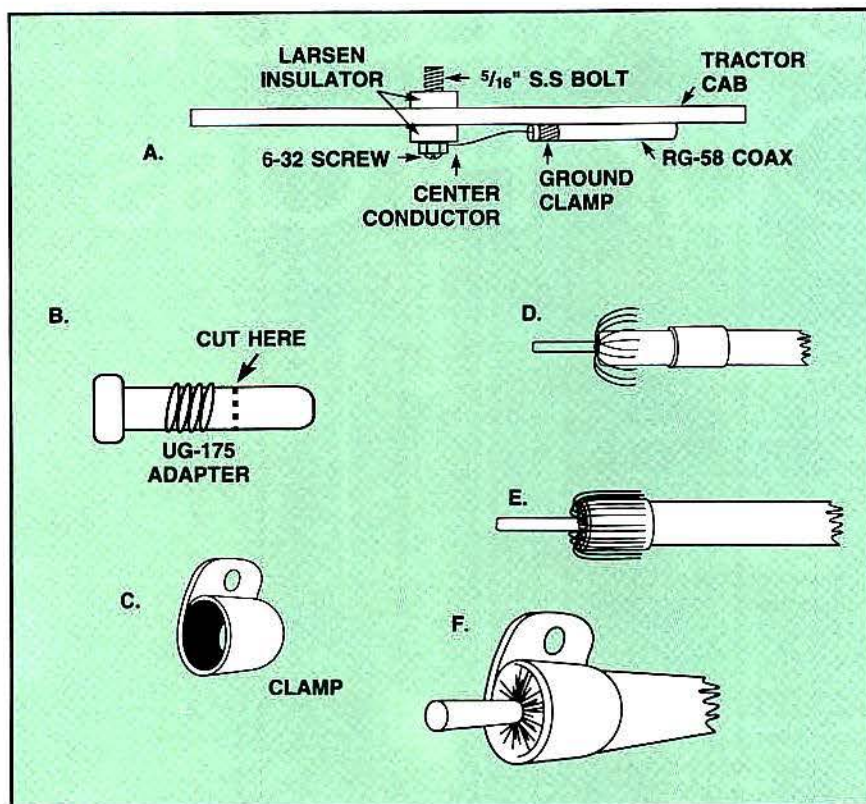


Figure 2. (A) The basic antenna assembly as installed on the tractor cab. (B) A UG-175 reducer makes a ferrule to fit between the coaxial cable and the flared shield, providing a better connection for the grounding clamp. (C) The grounding clamp used to connect the shield to the tractor cab. (D) RG-58 coaxial cable with the ferrule slipped on and the braided shield flared out. (E) The RG-58 shield has been folded back over the homemade ferrule and is ready for the clamp. (F) The RG-58 coaxial cable with the clamp installed is ready to mount to the tractor cab.

The coaxial cable's shield connects to ground (the top of the cab) as near to the center-conductor connection as possible. It is important for the shield to be connected close to the center-conductor connection.

Similarly, it is important for the center conductor lead to be kept short where it extends beyond the shield. A long, drooping center conductor can make it impossible to tune the antenna properly.

The series of drawings in Figure 2 to the left show how the base components are assembled on the tractor cab.

At A, the complete assembly is shown in place.

At B, a UG-175 reducer for a UHF connector (PL-259) is cut near the threads to make a ferrule to fit between the coaxial cable and the grounding clamp. This ferrule provides a hard surface against which to tighten the clamp to give a good connection for the ground.

The grounding clamp is shown at C.

At D, the ferrule is slid over the RG-58 coaxial cable, and the braided shield is flared.

It is important for the shield to be connected close to the center-conductor connection.

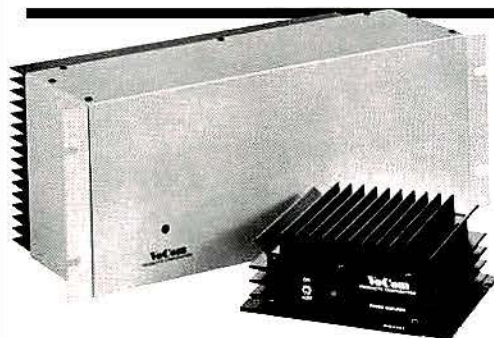
At E, the flared shield is folded against the ferrule.

At F, the grounding clamp is slid over the ferrule and shield.

The grounding clamp is connected to the tractor cab with a screw and nut or just a screw if the hole is threaded. Other techniques may be used to provide a good, low-resistance ground.

If you must install such an antenna, remember to keep the ground connection short and near the center conductor's connection to the antenna. Also, remember to keep the center-conductor lead as short as possible.

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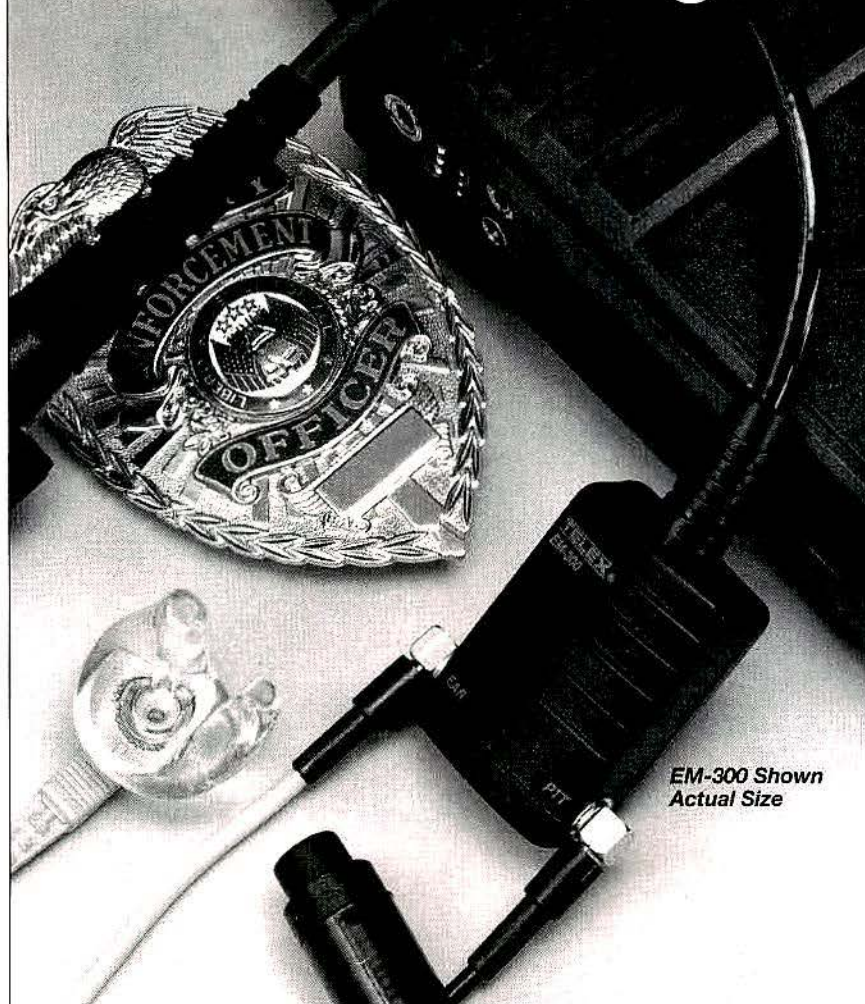
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TELEX

The antenna is located at the center of the guard ring (not shown in Figure 2).

Because of extreme vibration, it is necessary to use Locktite compound on the spring and the set screws that hold the whip in the end of the spring. Otherwise, these pieces may loosen and fall off.

Use a lockwasher on the 6-32 screw for the center conductor and on the grounding clamp. Use stainless-steel screws and washers throughout.

You may wonder about the VSWR resulting from the proximity of the guard ring to the antenna and the type of connections. With careful installation, a VSWR of less than 2:1 can be achieved over the 151MHz-159MHz frequency band.

Because of extreme vibration, it is necessary to use Locktite compound on the spring and the set screws that hold the whip in the end of the spring.

A VSWR of 2:1 in itself only causes a 0.5dB transmission loss. The radio set's automatic power reduction circuit causes a further loss of about 2dB; nevertheless, it is better to have an antenna system with a 2.5dB loss than no antenna system.

Though it may not be the perfect solution to the antenna problem, this antenna has proved to be extremely durable. Maybe the day will come when one can buy an off-the-shelf antenna that will stay on a tractor cab for more than one trip into the forest.

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Circle (19) on Fast Fact Card

Picking oscilloscopes for radio servicing

Two-way radio and radiopaging communications technicians can take advantage of improvements to analog oscilloscopes. A careful evaluation of service needs helps to show which instrument is economical and adequate.

By Mike Hoyer

When you purchase an oscilloscope, let your needs, not money, do the talking. It may not be necessary to invest in a more expensive digital storage oscilloscope (DSO) when an analog oscilloscope may be more economical.

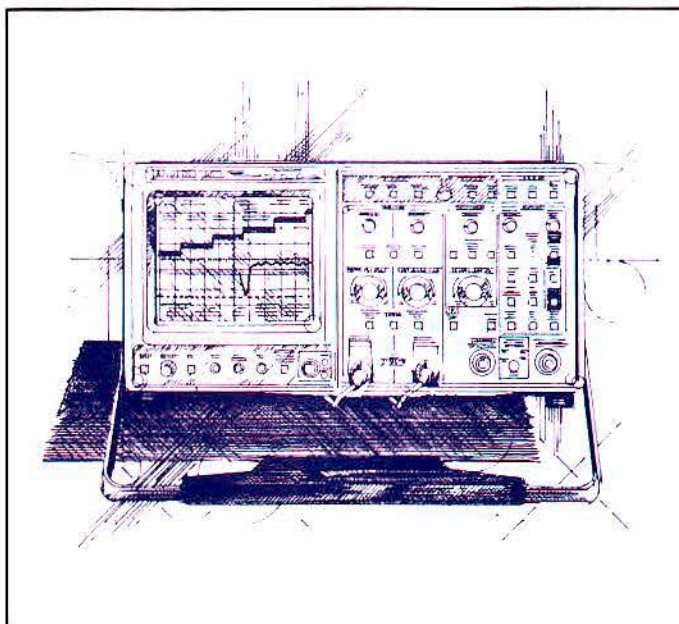
If you carefully analyze the applications for which you will be using the oscilloscope, it will help you to make the right choice. Many radio service shop applications require analog oscilloscopes. Analog oscilloscopes have come a long way in becoming more effective test instruments. Manufacturers of these products have added contemporary features previously seen only on DSOs.

But some field service applications may require a DSO. So how do you know when you need to buy the more expensive DSO?

Choosing a price tag

DSOs come in handy when measuring low frequencies and single events, and saving and printing waveform information that may be needed for some bench service and field service applications.

When this article was written, Hoyer was product marketing manager for Leader Instruments, Hauppauge, NY.



For example, a portable, 2.5-pound, battery-operated combination two-channel DSO-digital multimeter comes in handy for field service applications where saving and printing waveforms may be required.

If your application does not require measuring low frequencies or single events, or saving and printing waveforms, then you can save a lot of money by choosing a less expensive analog oscilloscope.

Often, an analog oscilloscope may be all that is needed for most service applications. Typical 60MHz and 20MHz battery-powered, full-featured portable analog oscilloscopes meet a field technician's requirements of small size (three inches high), light weight (nine pounds) and battery operation (built-in battery charger).

Bringing an oscilloscope to the field today does not mean sacrificing the full features of a laboratory oscilloscope.

Analog oscilloscopes are one of the most important items to have on a test bench. They help to assure that service problems are diagnosed and that technicians make repairs as quickly and efficiently as possible.

Today's analog scopes provide the user with many advantages:

► **Ease of use**—It is not necessary to go through extensive menus, as may be the case with many

DSOs.

► **Accuracy**—More analog oscilloscopes than DSOs offer dual time base and delayed sweep. This capability allows more accurate measurements of any portion of the signal seen in the main time base by enlarging a small section of the signal with a faster sweep speed in the delayed time base.

► **Sensitivity**—More analog oscilloscopes than DSOs offer higher sensitivity. Sensitivities as high as 500 μ V and more are offered on many analog scopes, whereas the common sensitivity on current DSOs is about 2 μ V.

► **Autoranging**—Autoranging selects from many time base settings to display an optimum number of cycles of the waveform. This feature continuously alters the time base with respect to the changing input signal.



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► **Video**—Full video line selection in NTSC or PAL (for even or odd fields) provides the capability to observe individual lines of video.

► **Cursors**—Cursors make it easier to measure voltage, period, frequency, phase, voltage difference and time difference ratios, and they automatically provide readout analysis without the need for equating.

► **Readouts**—Cathode-ray tube (CRT) readouts provide easier observation of front-panel settings, including mathematical computation of $\times 10$ probe sensitivity. The readout is useful when taking photographs of the waveform because all setting conditions appear in the picture.

Options

Another recent introduction is a 100MHz, three-channel, dual time-base analog oscilloscope that features six-trace capability with 500 μ V sensi-

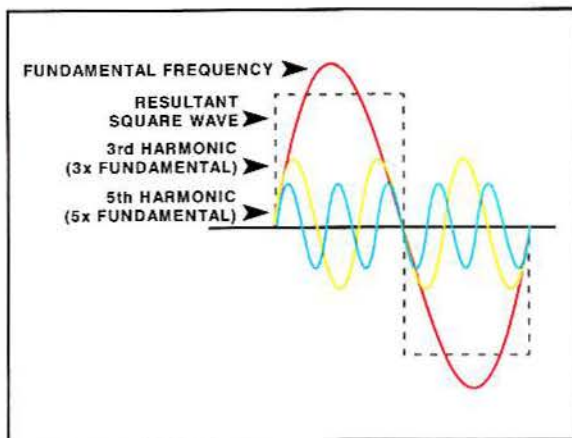


Figure 1. Fourier analysis shows that a square wave consists of the fundamental sine wave plus sine waves that are odd-numbered harmonics of the sine wave.

tivity and 5ns maximum sweep speed for easy analysis of low-level and high-speed signals. This oscilloscope has a broad range of features, including alternate triggering for simultaneous display of two asynchronous signals, alternate time base for observation of both the main and delay time bases and variable holdoff. The high-intensity CRT and extensive trigger-

ing controls provide a bright and stable display of complex signals.

For video signals, TV-V1, TV-V2 and TV-H sync separator circuits allow optimum triggering, including video line selection. Simultaneous observation of vertical and horizontal TV signals is provided by alternate time base.

Another oscilloscope allows the user to observe waveforms, setting conditions and measured values on a single display. Setup time is reduced by displaying important setting

conditions, including factor input coupling vertical mode, main and delayed sweep time and triggering controls. On-screen cursors provide direct readout of measured values.

More than any other factor, bandwidth affects oscilloscope price. Thus, it is important to specify bandwidth requirements with care.

Analog bandwidth is defined as the

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- Remote Unit Radio Check with ack
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- Stuck-Mic & Time-Out-Timer with ack & alert tone
- Automatic data muting
- Fully field-programmable with over 30 parameters
- 3 year no-hassle warranty

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- Automatic data muting
- RFI shielded enclosure
- 19" rack mountable
- 3 year no-hassle warranty



C-MARK IV Dispatch Display (above) and the **CDT-1** desk top terminal (right) work together to display and control your remote radios from the dispatch center.

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frequency at which a sinusoidal signal is attenuated by a factor of 0.707 or reduced to 70.7%. (This is called the -3dB point.)

For example, a 1V, 20MHz oscilloscope would appear to be about 0.707V. In choosing an oscilloscope, consider the most complex signals, such as square waves, video signals and digital logic signals, because they

are appearing in electronic products more and more.

Square waves consist of an infinite number of sine waves.

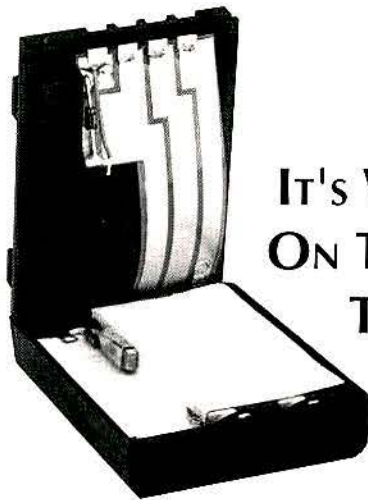
Five times the highest fundamental frequency to be measured gives an idea of the bandwidth required in an oscilloscope. (Note: EIA recommends 100MHz bandwidth units for servicing computers, televisions, monitors and

similar products.)

How do you arrive at the "five times the highest fundamental frequency?" The Fourier analysis calculation shows that the fundamental frequency contributes about 81.17% of the square wave. Then the third harmonic contributes about 9.02%, and the fifth contributes about 3.24%. These harmonics make a significant contribution to the square wave and, if removed, they leave the fundamental frequency, which would appear as a sine wave. (See Figure 1 on page 24.)

The higher the harmonic, the less contribution it makes to the square wave and, therefore, the less important the harmonic becomes.

Fundamental frequency and its third and fifth harmonics make up 94% of



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digital logic signals,
because they are
appearing in electronic
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Time-saving tips for RF power measurement

Use a No. 47 lamp as an RF power indicator to speed RF amplifier troubleshooting. Modify an in-line wattmeter and use it with a jumper cable to make RF power measurements more quickly.

By E. Kirk Ellis

Two-way radio technicians can save time in troubleshooting and making measurements by building an RF power indicator and by modifying an in-line wattmeter.

RF power indicator

Isolating a bad stage in an RF amplifier is made easier with an RF power indicator.

An RF millivoltmeter normally is unsuitable for the task without the risk of burning out the probe because of high RF voltages in an amplifier.

Troubleshooting in the field is easier with a go/no-go relative RF indicator built with an incandescent lamp, heat-shrink tubing and a brass screw.

Figure 1 to the right shows the RF indicator's construction.

File a #6-32 x 1-inch brass screw's tip to a point and remove the screw head. Solder the end where the head was to the solder blob at the base of a No. 47 6.3V lamp.

Place over the screw a piece of heat-shrink tubing slightly larger than the screw and apply heat to shrink it, leaving the

filed end of the screw exposed.

Place another piece of heat-shrink tubing large enough to cover the lamp and the socket over the two of them

and connect the pointed end of the screw to the inputs and outputs of the RF amplifier under test. The tester does not need to be connected to ground for RF energy to illuminate the lamp.

As you move the tester from input to output, the lamp should glow brighter. When it is moved to a faulty stage, the lamp grows dimmer or does not glow at all.

In a few circuits, the lamp may glow dimmer when moved from an input to an output even though the stage is good. This difference probably is caused by an impedance change from input to output. Nevertheless, the tester shows whether RF is present. You can make comparative checks on a known good amplifier if there is any doubt.

The No. 47 bulb works for 5W to 100W of RF, although it glows extremely bright at the higher power.

For portable radios and excitors, a smaller bulb, such as a No. 222 2.5V bulb, can be used. This bulb works in a power range from a few hundred milliwatts to around 10W.

A larger bulb, such as a No. 1156 12V bulb, may work for power levels above 100W, but I have not tried it.

Be sure to put heat-shrink tubing on the tester to prevent accidental contact with RF. It can cause nasty burns. Do not look directly into the bulb end of

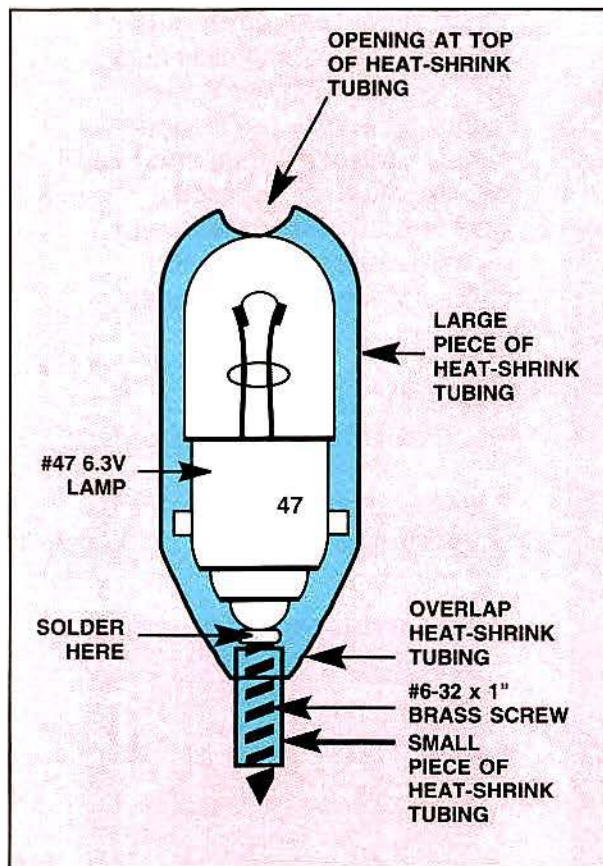


Figure 1. The RF power indicator is made from a #6-32 x 1-inch brass screw, a No. 47 6.3V lamp and two pieces of heat-shrink tubing.

and apply heat to shrink the tubing over the assembly, leaving a small hole at the top of the glass bulb.

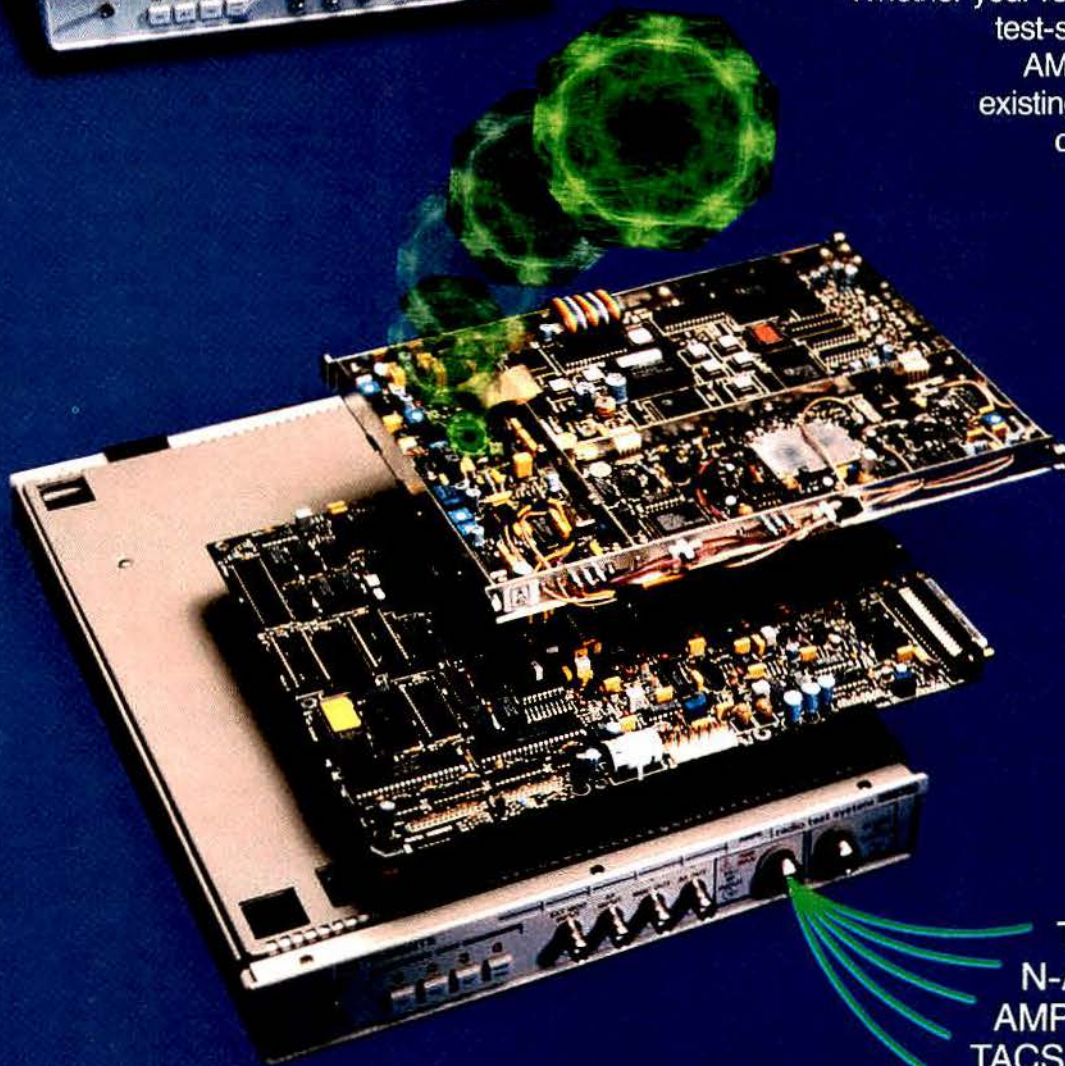
To use the RF tester, touch the sharp-

Ellis is telecommunications technician with Carolina Power & Light, Raleigh, NC.

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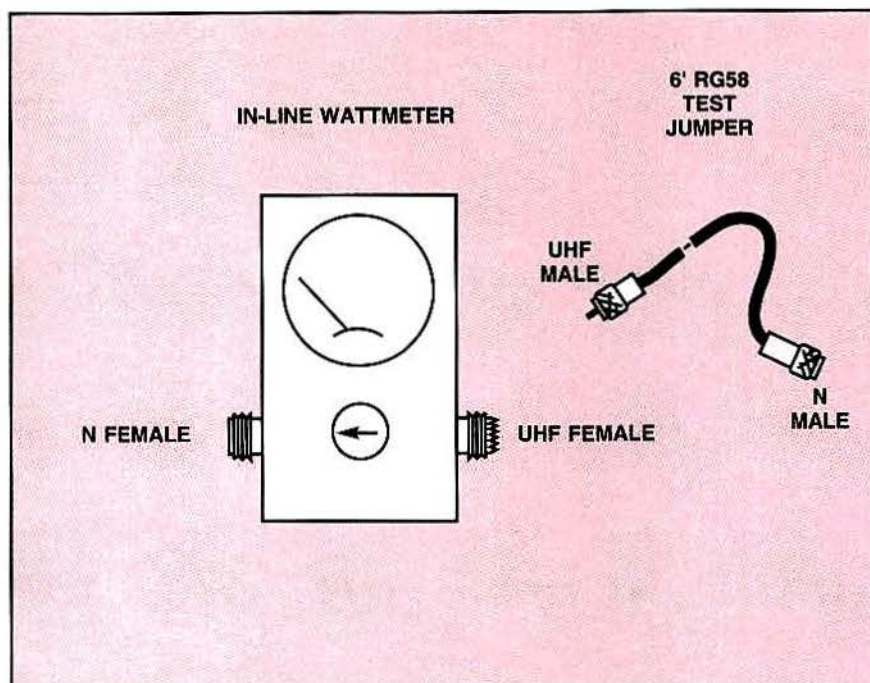


Figure 2. Modify an in-line wattmeter by replacing one connector so the meter has one type N female connector and one type UHF female connector (SO-239). Make a 6-foot coaxial jumper cable with a male type N connector at one end and a male type UHF connector (PL-259) on the other.

the tester when it is lit unless you are sure it is not emitting a blinding light.

This tester is a handy, cheap and extremely portable test instrument that works on numerous RF power circuits.

In-line wattmeter

An inexpensive in-line wattmeter modification saves much time and effort.

In-line wattmeters normally come with either type N female or type UHF (SO-239) female connectors installed. By replacing one of the connectors to the other type and making a 6-foot coaxial jumper cable, you can check transmitter installations faster. (See Figure 2 to the left.)

Make a 6-foot jumper cable using RG-58 coaxial cable with a type UHF male connector (PL-259) on one end and a type N male connector on the other.

Replace one of the in-line wattmeter connectors with a type N female connector or type UHF female connector (SO-239), whichever is the opposite of

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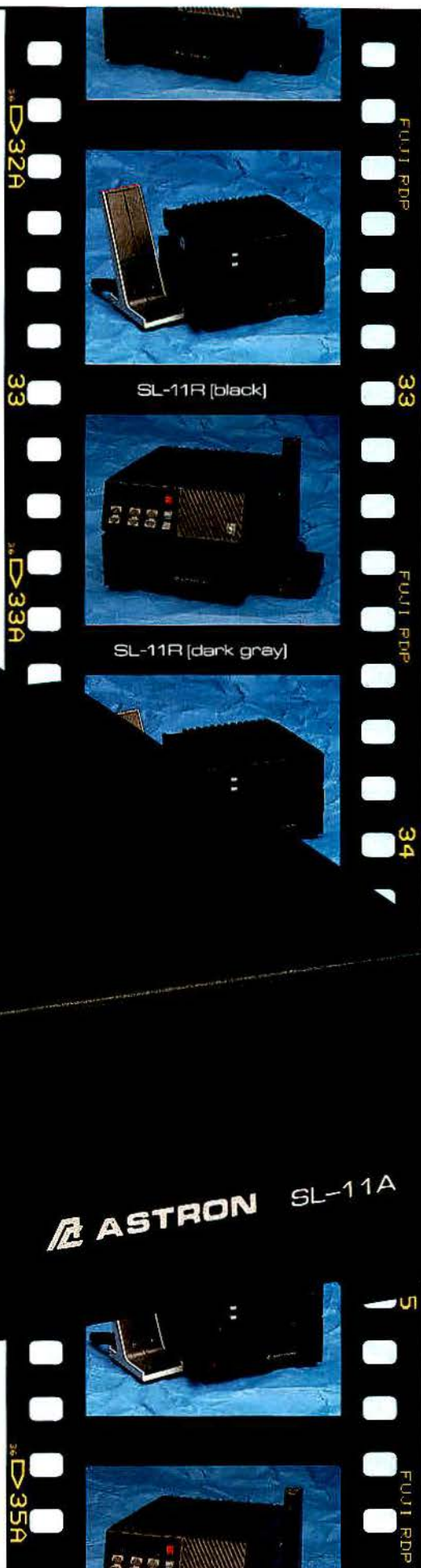
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SL-11R [black]

SL-11R [dark gray]

ASTRON SL-11A

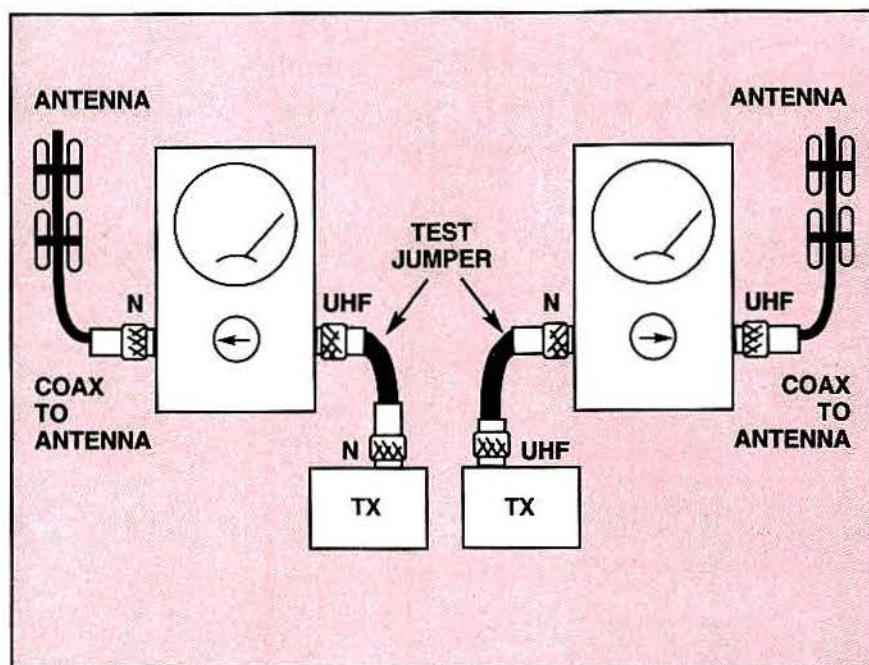


Figure 3. Use this test setup to measure RF power for a base station with a type N male connector on the feedline and a type N female connector on the transmitter chassis.

Figure 4. Use this test setup to measure the RF power of a base station with a type UHF male connector (PL-259) on the feedline and a type UHF female connector (SO-239) on the transmitter chassis.

the connector type supplied.

For example, suppose you need to check a base station with a type N male connector on the feedline and a type N female connector on the transmitter chassis. Normally, an adapter cable, jumper cable or both are required to connect an in-line wattmeter.

With the jumper cable and modified wattmeter, begin by connecting the PL-259 end of the jumper cable to the in-line wattmeter's female UHF jack. (See Figure 3 to the left.)

Next, connect the feedline's type N male connector to the other side of the wattmeter. Then connect the jumper cable's male type N connector to the transmitter, and you are ready to make RF power measurements.

Figure 4 to the left shows the reverse setup for checking a transmitter with UHF connectors.

This modification saves setup time in many, if not most, of the applications where an in-line wattmeter is used.

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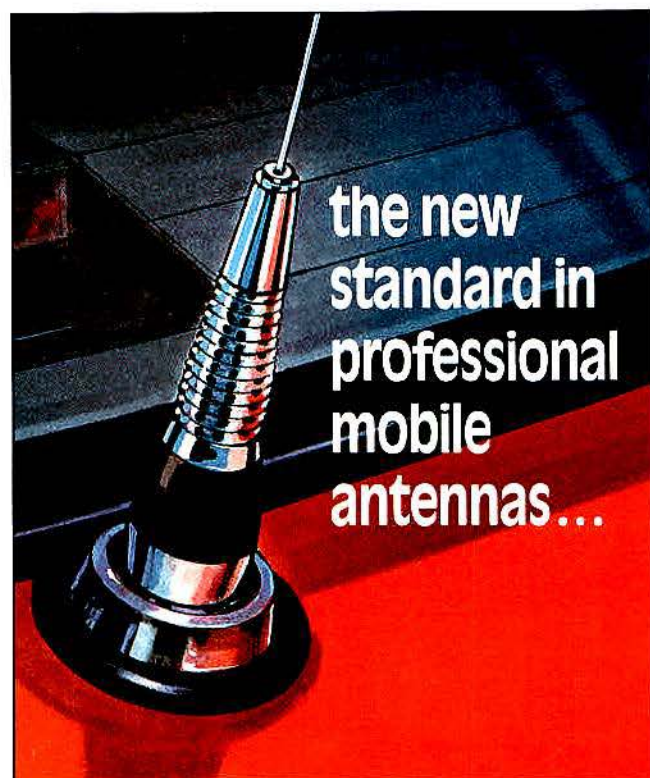


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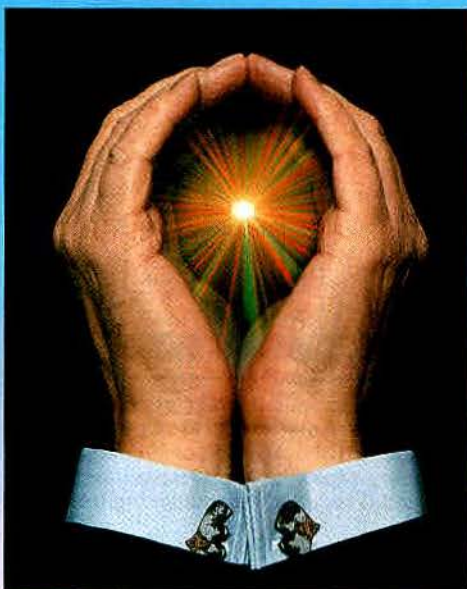
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Taking care of NiCd batteries for portable transceivers

Proper care, including charging, discharging and reconditioning, improves NiCd battery reliability. Advanced functions make battery analyzers easier to use and accelerate management procedures.

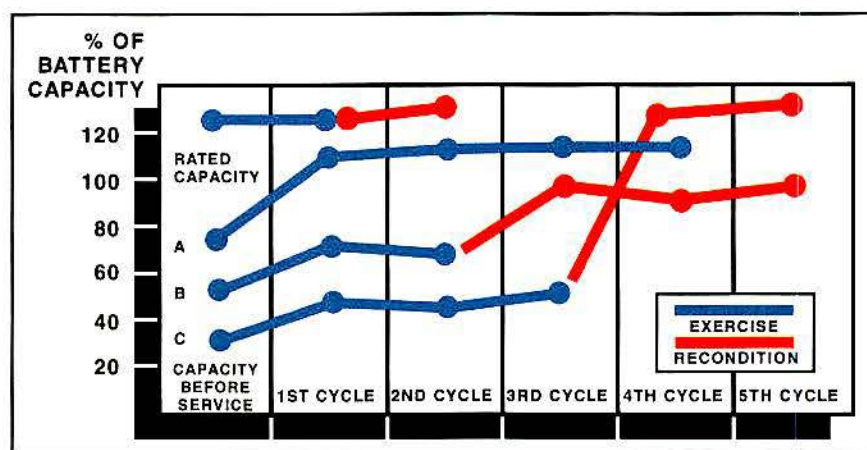


Figure 1. A new battery and three batteries afflicted with various degrees of memory were studied. All batteries first were fully recharged and then discharged to 1V per cell. The resulting capacities are plotted on a scale of 0% to 120%. An additional charge-discharge cycle was applied (blue line), and the battery capacities were re-evaluated. Battery A responded well to exercise. Batteries B and C required reconditioning (red line) to recover full performance.

By Isidor Buchmann

The performance and reliability of portable instruments are improving steadily, but the nickel-cadmium (NiCd) battery remains the weakest link in most systems.

Unexpected down time, excessive replacement costs and frustration often are the results of poor battery performance. An automated, comprehensive approach prolongs battery life, improves battery reliability and streamlines record-keeping.

In spite of some shortcomings, the NiCd battery remains one of the most popular power sources for hand-held

two-way radios and cellular telephones. Its success is attributed to its ease of recharge, good energy-to-weight ratio, wide temperature range, simple storage and economical price.

The NiCd battery has unique requirements, nevertheless, that must be met to achieve satisfactory performance. A NiCd battery's usable life in a satellite application, for example, is 17 years or 70,000 charge-discharge cycles. This long service life is achieved by a monthly discharge to 1V per cell.

Closer to earth, the commercial NiCd battery's life expectancy is less. Without applying regular maintenance, the NiCd battery deteriorates to the point of malfunction in 10 to 15 months.

NiCd batteries' longevity is related to how they are used. In many ways,

the NiCd battery exhibits human characteristics. It performs best at cool room temperatures and requires exercise to remain in good condition. The importance of exercise is illustrated in the following study.

A Canadian parks board had to replace all of its NiCd batteries after a short service life. Lack of regular exercise was suspected as the cause of failure. After acquiring a new set of batteries, the management implemented a monthly battery exercise program.

The first exercise inadvertently was delayed by four months. At that time, a careful analysis was made to evaluate the battery condition. The results were startling: half of the batteries analyzed already exhibited a memory-related capacity loss of 25% to 35%.

Buchmann is chief executive officer of Cadex Electronics, Burnaby, British Columbia.

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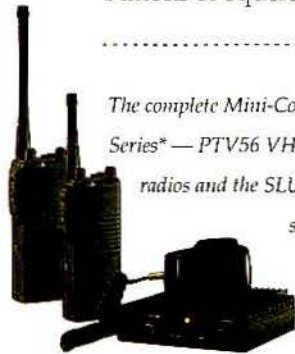
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Because these batteries never had to do a full day's work, they acquired the attitude "Why should I work hard if I don't have to?" With exercise and reconditioning cycles, all batteries were restored to 100% capacity.

Portable communications batteries commonly fall into the pattern of light duty followed by routine overnight charge. This lack of exercise causes the NiCd cell to revert to a lower oxide state, resulting in voltage depression or *memory*.

NiCd battery memory refers to a condition in which the battery's active materials, nickel and cadmium, form crystals with spikes or tree-like dendrites that cause the battery to lose performance gradually.

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Reconditioning consists of a controlled deep discharge below the 1V per cell threshold. Battery analyzers with the reconditioning feature commonly restore NiCd batteries affected by memory to 100% capacity.

Figure 1 on page 36 shows the results of comparing a new battery and three batteries afflicted with various degrees of memory.

In advanced stages, the dendrite can puncture the separator material, causing high self-discharge or an electrical short.

Memory is reversible by applying one or two discharge cycles to 1V per cell. This procedure is called *exercise*. In advanced cases, exercise may not be sufficient to restore a battery, and *reconditioning* is required.

All batteries first were fully recharged and then discharged to 1V per cell. The resulting capacities are plotted on a scale of 0% to 120%.

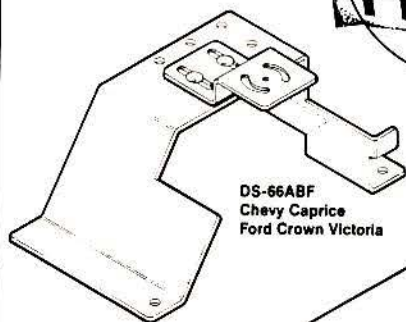
An additional charge-discharge cycle was applied (blue line), and the battery capacities were re-evaluated.

Battery A responded well to exercise. This reaction is typical of a battery that had been in service for only

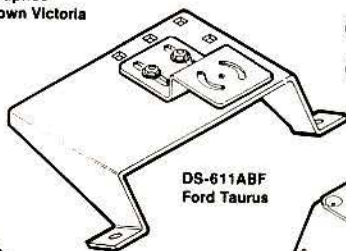
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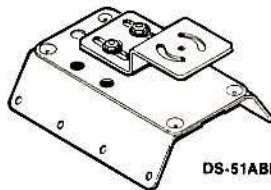
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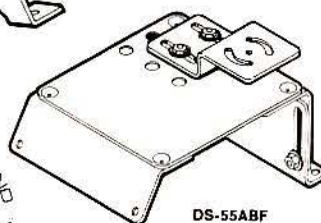
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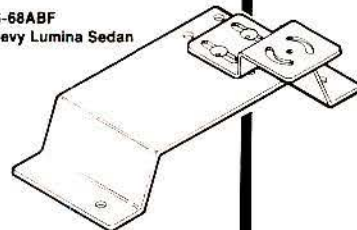


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a few months or that had been exercised periodically.

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Technology is available to provide

the required battery maintenance automatically. Advanced battery analyzers can identify and effectively reverse the degeneration process of NiCd and other battery chemistries.

An important criterion for a battery analyzer is the ability to accommodate a variety of battery types, such as NiCd, nickel-metal hydride and lead-acid. Some analyzers meet this require-

ment with interchangeable battery adapters, such as configured cups or user-programmable cables.

One battery adapter contains an embedded memory chip that stores the battery's characteristics. Entering or altering the configuration code via menu command programs the analyzer. The battery conditions are retained when the adapter is removed or the power is turned off.

With sufficient automation, the analyzer can determine whether a battery is usable by measuring actual capacity against its rated capacity on a percentage scale.

A high target (90% to 100%) should be chosen when reliability and adequate capacity reserve are critical. For less stringent applications, a lower

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*An important criterion
for a battery analyzer is
the ability to
accommodate a variety
of battery types, such as
NiCd, nickel-metal
hydride and lead-acid.*

setting (60% to 70%) may be chosen for the automatic measurement.

If the battery does not achieve the selected capacity level with an ordinary recharging, it is reconditioned automatically. Reconditioning usually restores the battery's performance.

Further improvement in fast-charging NiCd batteries has been achieved with a reverse-loading technique. Reverse loading intersperses discharge currents between charge pulses throughout the charging cycle.

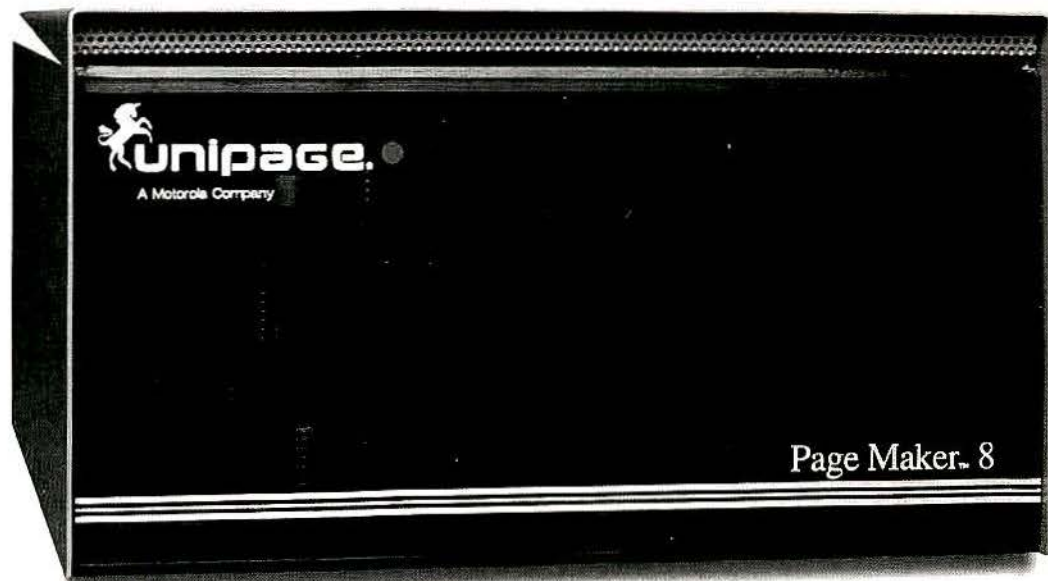
This technique achieves a cooler and more effective charge than conventional charging. The memory phenomenon is reduced because the battery is stimulated while charging. The result is a prolonged battery life.

A NiCd battery should not be left on trickle charge for prolonged periods because degeneration due to memory occurs. On the other hand, a battery on the shelf is subject to significant self-

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Circle (36) on Fast Fact Card

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discharging. These two characteristics make it difficult to maintain fully charged NiCd batteries on demand.

One way of maintaining batteries at operational readiness for an unlimited time is to apply discharge-charge cycles once every 30 days to prevent memory.

Batteries can be labeled with date, capacity and fault codes from their most recent analysis. Labels keep the user informed about battery performance. A service report can be prepared to summarize the battery's performance and possible problems.

Selecting the analyzer

There is a noticeable trend toward automated battery maintenance. Such systems are becoming an indispensable tool in assuring a high level of confidence in rechargeable batteries. Users can select from many analyzer functions offered by various vendors.

When shopping for a battery analyzer, the buyer should know what to expect from a low-cost analyzer and

what a more advanced unit can offer. For example:

► An analyzer should accommodate a large variety of battery types, including lead-acid.

When shopping for a battery analyzer, the buyer should know what to expect from a low-cost analyzer and what a more advanced unit can offer.

Programmable units that allow the user to set voltage, current and other characteristics have an advantage because they are the most flexible, and they will not become obsolete when

new batteries are introduced.

► An analyzer must prevent battery overcharging.

Some analyzers detect a NiCd battery's full charge with the negative slope method only. Batteries with mismatched cells or other defects do not produce an adequate slope to terminate the fast charge reliably. In this case, a battery can be overcharged until damaged or destroyed.

► An analyzer should have the capability to recharge batteries affected by memory.

Without this feature, batteries in advanced stages of memory often do not recover with a discharge-charge cycle to 1V per cell alone.

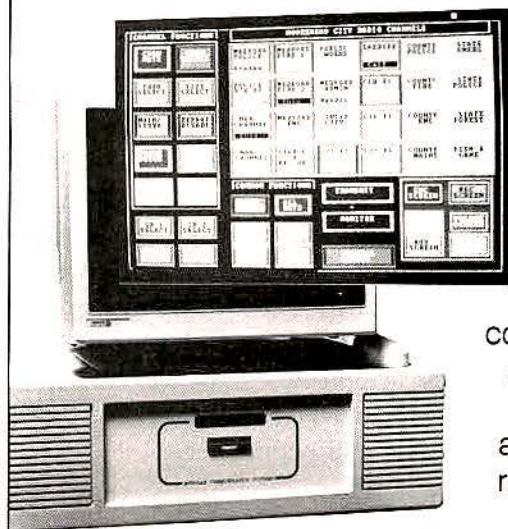
► An analyzer should display the residual as well as the final battery capacity.

Problems such as insufficient capacity reserve at the end of the work shift thus can be identified and corrected.

► An analyzer should identify a battery with low voltage.

It is possible for a battery to show a

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good capacity reading despite a shorted cell that causes low voltage. A shorted cell can cause serious problems in the field.

► An analyzer should have user-selectable programs.

Units with sophisticated decision-making capabilities have an advantage because they eliminate trial runs, reduce handling and simplify operation.

► An analyzer should be easy to use by non-technical staff.

Capacity readout in percentage rather than milliampere-hours is more convenient because the operator does not have to be familiar with the milli-ampere-hour ratings of each battery type analyzed.

A non-technical user may prefer a

Systems that produce stick-on labels that fit on batteries simplify battery maintenance.

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simple pass-fail light signal in addition to a display. This function is especially helpful on a larger system because it helps to differentiate good batteries from unserviceable ones at a glance.

► An analyzer should provide fast service.

Typical charge time should be less than two hours. The discharge rate should be 1C, which is defined as 60 minutes at 100% capacity. Faulty batteries should be identified quickly to free the charging slot for other batteries.

► An analyzer should be capable of printing reports about tested batteries.

Systems that produce stick-on labels that fit on batteries simplify battery maintenance. By always attaching the labels to the battery, the user stays informed about the battery's performance and the date of its last analysis.

Analyzers that provide event log data to a computer allow the user to produce charts and to study battery performance further.

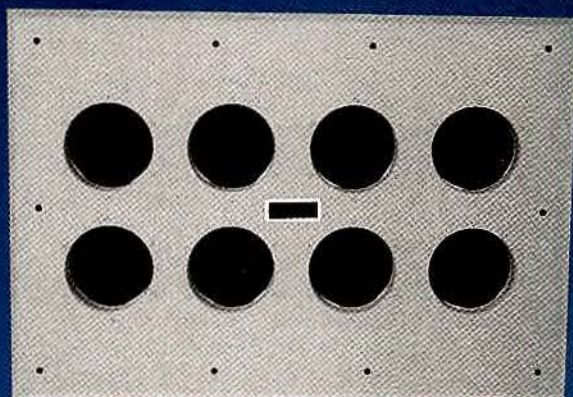


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Technically speaking

Formula 3

$\mu\text{V/m}$

$$= \text{antilog} \left[\frac{20\log(\mu\text{V}) - G_R + 20\log F + L_L - 32}{20} \right]$$

Formula 4

$\mu\text{V/m}$

$$= \text{antilog} \left[\frac{\text{dBm} - G_R + 20\log F + L_L + 75}{20} \right]$$

where

μV = signal level at receiver input in microvolts

dBm = signal level at receiver input in decibels above 1mW

G_R = antenna gain of the receiving antenna in dBd

L_L = line loss in decibels

F = frequency in MHz

(continued from page 8)

problems are of the nuisance type and can be solved by using different codes on coded squelch systems.

Compromising solutions

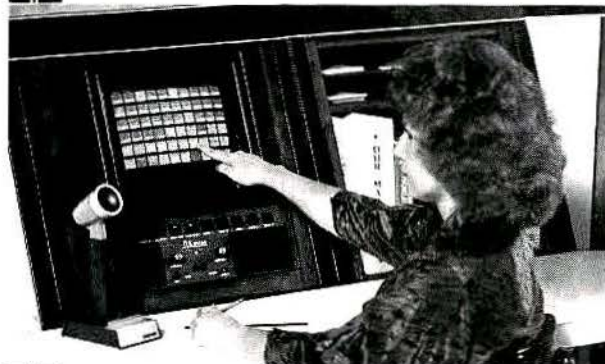
With destructive interference, a different approach is required. The best method of combatting co-channel destructive interference is for the two co-channel users to meet and to work out an arrangement that is mutually beneficial and acceptable to both parties.

Some of the factors that might be adjusted to minimize interference include the antenna height, antenna gain, antenna orientation, transmitter and antenna location, and transmitter power. It may be necessary to try a combination of several of these methods to effect a satisfactory solution.

Last resort

Obviously, if all else fails, it will be necessary to request intervention from the FCC.

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Such a request should be avoided if at all possible. If it is necessary, then you should be well prepared with documentation to show that the other party is indeed causing destructive interference to your radio system.

Logs showing dates and times of the destructive interference might prove helpful. Tape recordings of transmissions being blocked by the offending signal are useful in proving a case of blocking or serious degradation of the desired signal.

You should have plenty of recorded signal level readings on different dates and times for the FCC's examination and consideration.

Signal level measurements

The simplest method of measuring the offending signal's level is to use a spectrum analyzer as shown in Figure 1 on page 8.

Most spectrum analyzers measure signal level in dBm units. If you want to convert dBm units to microvolts, use the following formula:

$$\mu V = \text{antilog} \left[\frac{\text{dBm} + 107}{20} \right]$$

(1)

Example: Suppose, using the setup in Figure 1, the signal level was found to be -90dBm. Substituting into the formula, we have:

μV

$$= \text{antilog} \left[\frac{-90 + 107}{20} \right]$$

$$= \text{antilog} \left[\frac{17}{20} \right]$$

$$= \text{antilog} [0.85]$$

$$= 7.08 \mu V$$

(2)

This is the signal level at the spectrum analyzer input, and it would be the same at a receiver input.

Receiver method of measurement

Another way to determine the signal

level at the receiver input (when metering points are provided) is to check the meter reading at the IF metering point with the signal on the air.

Record the meter reading for reference. Then, connect a signal generator to the receiver input and adjust the generator level to produce the same meter reading. Read the signal generator level in microvolts or dBm. This is

the signal level of the interfering signal.

Converting to $\mu V/m$

To convert the signal level at the receiver input in microvolts or dBm to field strength at the antenna in microvolts per meter ($\mu V/m$), use formula (3) or formula (4), as appropriate, in the box on page 46.

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Circle (43) on Fast Fact Card

Technically speaking

Example: The signal level in microvolts at the receiver input is $1.5\mu\text{V}$. The antenna gain is 6dB, and the transmission line loss is 3dB. The frequency is 160MHz. What is the field strength at the antenna in microvolts per meter?

Solution: Use Equation (3) and substitute:

Formula 5

$\mu\text{V/m}$

$$= \text{antilog} \left[\frac{20\log(1.5) - 6 + 20\log(160) + 3 - 32}{20} \right]$$

$$= \text{antilog} \left[\frac{3.52 - 6 + 44.08 + 3 - 32}{20} \right]$$

$$= \text{antilog} \left[\frac{12.6}{20} \right]$$

$$= \text{antilog} [0.63]$$

$$= 4.27\mu\text{V/m}$$

If the signal level at the receiver input were in dBm, you would use Equation (4) on page 46 to find the field strength in microvolts per meter at the antenna.

To determine how much the interfering signal is degrading the desired

signal, use the equipment setup shown in Figure 2 on page 8.

The *isotee* is a homemade coupling device that is very lossy and has a negligible loading effect on the line. It is made by removing the center pin from a T-connector, cutting it off short

and then reinserting it into the T-connector.

Then the female-female UHF adapter is attached to the T-connector. Because the T-connector's pin has been cut off, no direct contact is made between the double-female UHF adapter (barrel) and the T-connector; nevertheless, RF leakage within the connector provides some degree of coupling with considerable isolation between the signal generator and the line. Similar isolation couplers can be made with other types of RF connectors.

Measurement procedure

(1) With no incoming signal from the antenna and with the signal generator set to the correct frequency and modulated at $\pm 3\text{kHz}$ deviation, set the generator level to produce 12dB SINAD. Record the generator level in dBm. (It will take a high signal level to produce 12dB SINAD because of the loss or isolation of the isotee.)

(2) Wait for the interfering signal to make an appearance. When the interfering signal appears, increase the signal generator level to return the SINAD meter reading to 12dB SINAD. Record the new signal generator level.

(3) The difference between the generator levels in steps 1 and 2 in decibels is the amount of degradation the interfering signal is causing to the desired signal.

If your radio system operates at consistently stronger signals than the *minimum usable signal level* (12dB SINAD), then you might choose a higher input level as the reference. For example, $1\mu\text{V}$ might be a good choice if your signals are always this strong. Of course, the measurement would indicate less degradation at $1\mu\text{V}$ than it would at the $0.3\mu\text{V}$ level, for instance.

This information should help you to establish the magnitude or the severity of the interference problem. The severity of the interference may vary from day to day and time of day. If the problem occurs frequently and with severe degradation, it can render your radio system very unreliable.

But before taking your case to the FCC, arm yourself with information and documentation.

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E. F. Johnson marks 70 years in communications industry

E. F. Johnson marked the beginning of its 70th anniversary year by opening a newly remodeled company museum in Waseca, MN. The renovated, 700-square-foot museum is located in the Waseca Operations Center, site of the company's main engineering and manufacturing facility. More than 350 products from E. F. Johnson's history are on display in the museum, including samples of current radio communications products.

Hutton completes certification program

Hutton Communications, Dallas, has become a "Certified Andrew Distributor." Andrew, Orland Park, IL, has instituted a certification program to ensure that the quality of its products, including services such as cable connector installation, will be maintained to the same standards when purchased from a distributor. Hutton Communications distributes two-way communications and solar products in the southern United States.

Uniden appoints Canadian distributor

Uniden, Ft. Worth, TX, has reappointed Lenbrook Industries as the exclusive Canadian distributor of the company's two-way radio products. Lenbrook was the main distributor of Uniden products in the Canadian market in the '80s.

PRC wins public safety contracts

PRC, McLean, VA, has been awarded 13 contracts to provide computer-based public safety and criminal justice systems to state, county and municipal governments throughout the United States. The contracts are worth almost \$15 million. Government agency customers include Whatcom County, WA; San Mateo County, CA; Houston; Sonoma County, CA; Canadian Police Information Centre, Ottawa, Canada; Occanside, CA; Fairfax County, VA; Santa Ana, CA; Costa Mesa, CA; Portland, OR; Escondido, CA; Westminster, CA; and Greeley, CO. The PRC systems feature a variety of interfaces with organizations such as the National Crime Information Center, Washington, DC, and the Canadian Police Information Centre.

Fleet Call changes name to Nextel Communications

The Rutherford, NJ-based Fleet Call has changed its name to Nextel Communications. The new corporate identity has been adopted in conjunction with the introduction of Nextel, an all-digital, fully integrated wireless communications service, later this year.

"Changing our name to Nextel Communications more clearly reflects our efforts to provide our customers with the next generation of wireless communications," said Morgan O'Brien, Nextel's chairman.

The first Nextel mobile communications system is scheduled for launch in the greater Los Angeles area in August 1993. With the system, subscribers will use one compact, easy-to-use unit to access a congestion-free portable and mobile telephone system with fully integrated private network dispatch, alphanumeric paging and wireless data exchange functions.

Nextel Communications is headquartered at 201 Route 17 North, Rutherford, NJ 07070; 201-438-1400.

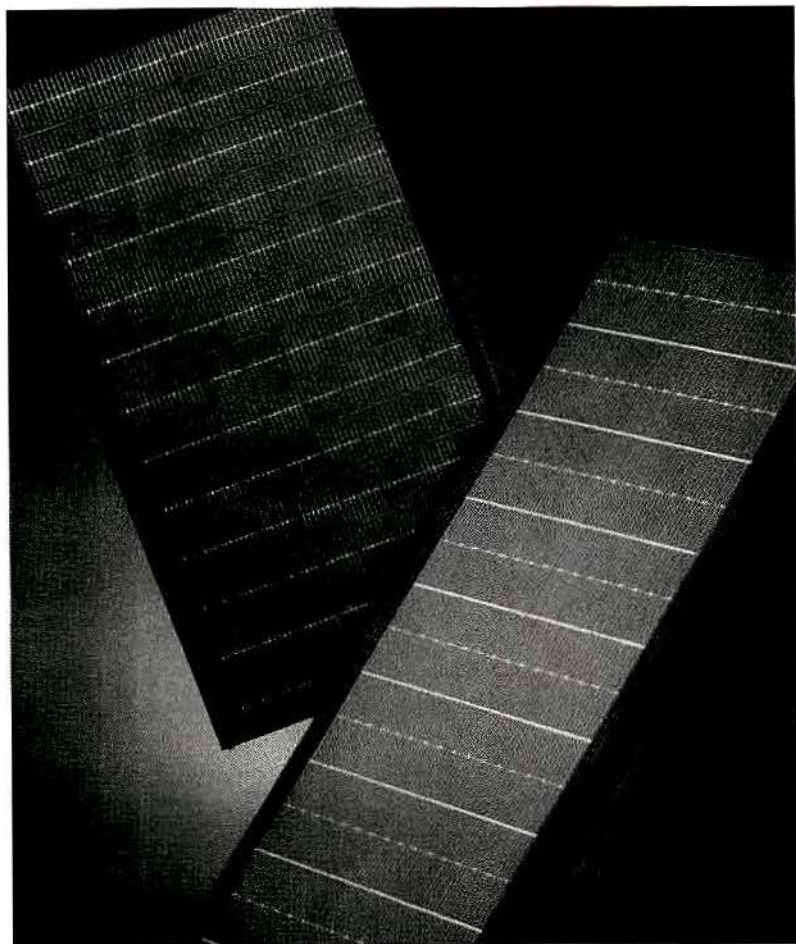
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Circle (45) on Fast Fact Card

Allen Telecom Group unites A/S, Decibel Products

The Antenna Specialists and Decibel Products, both wholly-owned subsidiaries of Allen Group, have become working partners within a new corporate structure known as the Allen Telecom Group. The two companies will continue independently to market their products under their traditional brand names but otherwise will pool their engineering, manufacturing and distribution strengths.

CeoTronics opens U.S. office for distribution, production

A Rodermark, Germany-based communication headsets and systems manufacturer, CeoTronics, has opened corporate headquarters for distribution and production for North American markets. Located in Carrollton, TX, the facility will be the center for administration, sales and final production. Products include PTT, Vox, Super Vox, inductive surveillance, contact microphone, wireless, cable bounded and intrinsically safe communication headsets and systems. CeoTronics is located at 2312 Trinity Mills Road, Suite 101, Carrollton, TX 75006; 214-416-9500.

The partnership is the result of the acquisition in July 1992 of Alliance Telecommunications by the Allen Group. Allen Telecom was formed to provide a focal point and management direction in capitalizing on the combined strengths of Antenna Specialists and Decibel, as well as two sister companies, db Mobile and Grayson Electronics.

Glenayre, AvData join forces on satellite paging network

Glenayre and AvData have established Glenayre Networking Services, a satellite-based link for networking paging and messaging terminals that by-passes problems associated with terrestrial landlines. Glenayre, Charlotte, NC, signed an agreement with AvData, Atlanta, to resell AvData's VSAT (very small aperture terminal) communications products and services to the North American paging industry, effective February 1993. By using Glenayre Network Services, paging operators can network many paging terminals without expensive leased lines or RF links.

NH State Police tests Astro digital system

The New Hampshire State Police, Concord, NH, has begun testing the Astro FM two-way digital communications system, designed by Motorola. It is the first system of its type installed by a public safety agency in the United States. The Astro digital system is one of the first systems to address the narrowband requirements being considered by the Associated Public-Safety Communications Officers (APCO) and the FCC.

SoftWright installs BBS for RF coverage software questions

SoftWright, Aurora, CO, has installed an on-line electronic bulletin board service (BBS) to answer questions about the company's Terrain Analysis Package (TAP). People with questions about microwave and radio coverage prediction software can call the TeleTAP bulletin board 24 hours a day with no access charge. Demonstration software is also available. TeleTAP can be accessed at 303-344-5378 using the protocol 8,N,1 at 9,600 baud or slower.

Advanced Features, New Design



The future of **EXTENDED LOCAL CONTROL** is here. The new model LE10 from CPI is a telephone style local extension designed for easy use with virtually any radio. The LE10 provides LED PTT indication, on-hook PTT capability, off-hook monitor, amplified speaker with volume control and adjustable amplified modulation output. The LE10 allows you to hear both sides of a transmission made from another desk-set or the radio microphone. The LE10 gives you all this in a newly styled modern package that brings extended local control into the 90's. Options: wall-mount

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Features

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- New modern styling
- One watt receive audio amplifier
- Use up to 1000 feet from base station



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Circle (46) on Fast Fact Card

BATTERY PROBLEMS??

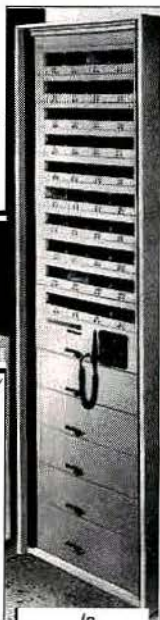
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LTR is a registered trademark of EFJ. Privacy Plus is a registered trademark of Motorola.

Circle (48) on Fast Fact Card

FCC takes steps regarding Phase II 900MHz SMR, 'spectrum refarming'

By Robert H. Schwaninger Jr., esq.

The FCC has revised some of its rules applicable to specialized mobile radio (SMR) systems and has issued a *Further Notice of Proposed Rulemaking* concern-

ing Phase II of the licensing of 900MHz systems.

New SMR rules

► *Continuous operation*—One of the new rules requires an SMR station to continue operation after construction is complete.

Some SMR licensees have engaged in the use of meeting construction requirements and placing a station in operation by using a "base station on wheels"—that is, placing a transmitter in service only temporarily, then taking the equipment away and using it for something else.

► *Digital station ID*—Stations that are licensed on an exclusive basis and that normally use digital signals to transmit data, text, control codes or digital voice may transmit the station call sign digitally, according to another new rule.

► *Secondary fixed operations*—The FCC decided not to redesignate fixed operations as co-primary to mobile operations. It also decided to continue its policy of not counting fixed station use of channels above 800MHz toward meeting loading requirements.

Phase II

It would appear as if there were no consensus within the FCC on Phase II, and the proposal looks more like a notice of inquiry than a set of rules for which the FCC can expect clear support or opposition.

► *Reallocation*—In its proposal, the FCC has tentatively decided to reallocate most of the 900MHz SMR Category channels to nationwide and regional systems:

(1) 60 channels for "nationwide compatible" systems, with 20 channels to be granted to each of three licensees.

(2) 120 channels for "regional" systems, with 20 channels to be granted to each of six licensees per region.

(3) 20 channels for "local" service, divided between two 10-channel systems.

Refarming 'clarification'

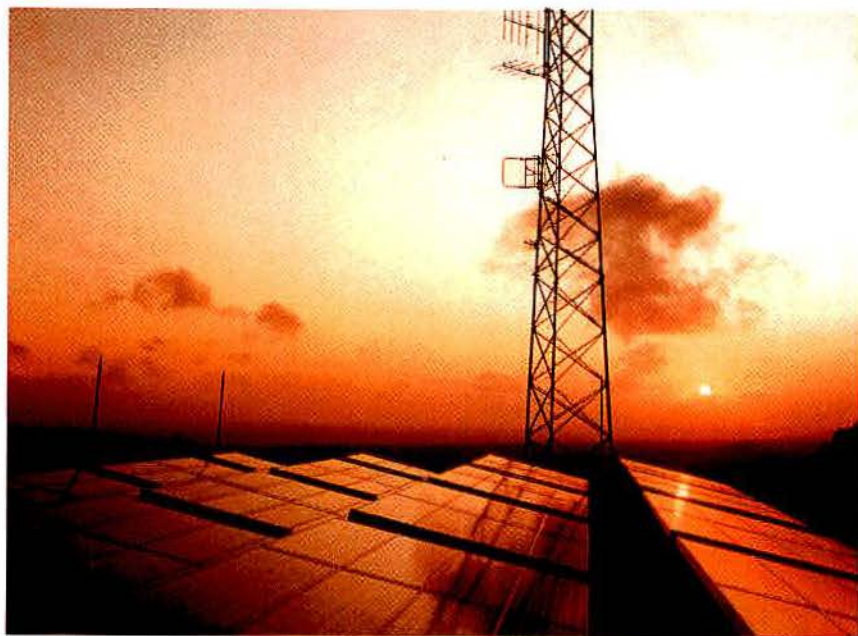
In an unusual action, the FCC Private Radio Bureau (PRB) has issued a *Public Notice* with a 6-page question-and-answer guide in an attempt to "clarify key issues" in the "refarming" rulemaking proceeding in which it proposes sweeping change in its regulation of the private land mobile radio services.

The action seems to indicate that the FCC is finding its proposals to be a *tough sell* in the marketplace of ideas and that it is willing "to permit alternative approaches," as the document reads.

► *Bandwidth reduction*—In response to the FCC's seemingly simple idea that the first step is to reduce transmitted bandwidth, many people have expressed the opinion that the FCC does not seem to

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Regulating technology

understand radio. Reducing transmitted bandwidth is relatively easy, but because few receivers can be tuned more narrowly than they are manufactured to tune, millions of receivers could have to be replaced as part of the first step.

"If that claim is true," the *Public Notice* reads, "the final rules will be crafted to prevent hardship," apparently meaning that the proposed 1996 effective date for the first step probably would be pushed back.

The FCC's apparent new recognition of physics and economics does not mean that the struggle is over. Electronics industry publications have carried numerous stories concerning the bonanza that equipment-makers have foreseen in the accelerated replacement of land mobile radios. More will be heard from the manufacturers and at least one FCC commissioner who speaks about setting national industrial policies and mandating the replacement of all existing radios.

► **Power reduction**—Seemingly in an effort to solicit support for its strongly opposed power reduction proposals, the notice reads that the FCC is "looking for industry input on a number of issues, including provision for wide-area and rural

needs, how to transition to these new limits, and on specific technical parameters."

Although the FCC may be correct in surmising that interference could be reduced if power were reduced, it seems to be having difficulty explaining to users why they should prefer to operate half a dozen base stations, rather than one.

► **Frequency coordination**—The notice reads that "the proposals will expand the role of coordinators and have a positive impact on the wide variety of users of private land mobile radio spectrum."

At an informal March 1 meeting in the PRB offices, bureau chief Ralph A. Haller lofted the idea that the FCC might simply license the frequency coordinators for all the channels, then let them grant licenses and deal with all the problems. He did not explain why, in such event, the FCC would continue to be necessary.

► **Carrier issue**—Some people who have analyzed the FCC's reforming proposals see in them a bias in favor of private and common carriage, as opposed to a radio user's meeting his own needs.

The FCC Q&A reads that "we would not force any user to a private or common carrier, and we anticipate such movement

only if the individual user sees using such carriers as being in their own best interest." The Q&A does not analyze whether the FCC proposals would limit a user's options in such a way as to favor migration to private or common carriers.

► **Service consolidation**—Apparently facing political opposition from people who would benefit from continuing the multiplicity of radio services and sub-radio services such as the Motor Carrier Radio Service, the Taxicab Radio Service and the listed alarm companies eligible for certain Business Radio Service frequencies, the FCC seems to be begging for support for simplifying the current frequency allocation structure.

After explaining the reasons for its plan to consolidate most of the radio services, the notice reads that the FCC is "seeking industry guidance on whether and how radio service consolidation should take place." The notice further reads that "the loss of spectrum from certain user groups is a sensitive topic, and we seek alternative proposals that could meet all our objectives, including those implicit in our innovative shared use proposal."



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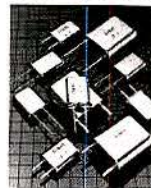
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Readers' choice

Of all the new products and services in the September 1992 issue, the ones reprinted here generated the most reader requests for additional information. If you missed them the first time, here is your opportunity to acquire more information on them: Just circle the corresponding Fast Fact Card number on the card found in the back of this issue and mail the card to us.

Ear audio receiver enables discreet monitoring

The ELS2000 Earhanger audio receiver fits most hand-helds and allows discreet monitoring of radio transmissions. The Sonic Communications earpiece is lightweight.



Circle (501) on Fast Fact Card

Vehicular repeater system suits EMS applications



The EMS1000 vehicular radio repeater system from Teletec enables a communications line to be established from a

patient's side via a portable radio with a DTMF pad. The system will repeat on all 10 UHF Med channels. The system allows the radio to operate as a regular simplex unit when communicating directly from the vehicle to the hospital. In addition to the Med channels, the system operates on any frequency from 450MHz-480MHz.

Circle (500) on Fast Fact Card

Self-tuning radio demodulates signals

The R-10 communications test receiver finds and demodulates signals. The Optoelectronics self-tuning unit features a built-in speaker and BNC out; 50Hz-5,000Hz demodulation; and search and lock-on modes.

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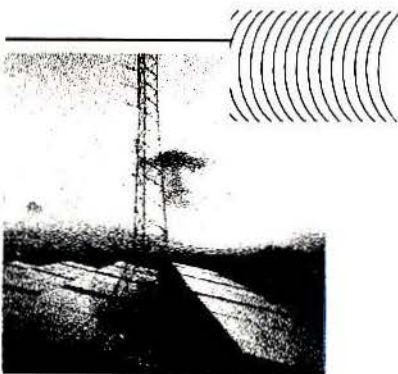
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Circle (57) on Fast Fact Card

New products

Program offers digital topographic data

Lattice from Applied Spectrum Research provides the user with a comprehensive, easy-to-use in-house propagation prediction tool. The program allows the user to look at the radio system as a whole, at individual sites or any combination of sites. It provides 3-second or 30-second digital topographic data, vegetation and urban influences, and antenna patterns.

Circle (250) on Fast Fact Card

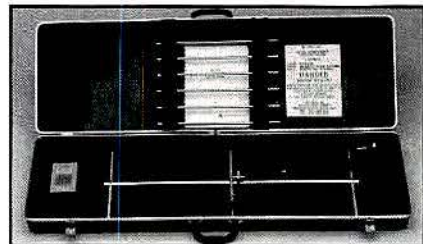
Trunking portable features 10 group codes per system

Model SPS 330TSD is a full-duplex, 800MHz trunking portable radio made by Uniden. It comes with a rechargeable battery, flexible antenna, belt-clip mount and standard-rate battery charger. The SPS 330TSD is fully compatible with Uniden's Fast, E. F. Johnson's LTR, Zetron and Trident trunking formats. Other features include 10 group codes per system, side-mounted PTT switch, call light, voice compander, 100-number memory, large LCD, speed dialer, manual over dialing, last number redial and system queuing.

Circle (251) on Fast Fact Card



Locator system pinpoints interference sources



The PLI-150 system locates all types of hardware that radiate electrical interference. The unit from Trilithic includes everything needed to conduct searches on-foot or in a vehicle. Features include a mobile mount and whip antenna for vehicle searches and a hand-held directional antenna for pinpointing the interference source. The PLI-150 is a fully calibrated system and uses a receiver that weighs less than one pound.

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Paging switch connects T-1, analog switches



Mega One, part of the Mega Switch line from **Hark Systems**, uses digital architecture to provide a 500-port switch. The unit can connect a combination of T-1 and analog interfaces, including 4-wire E&M, 2-wire loop, FXS and FXO. Mega One allows paging companies with analog equipment to use digital phone lines. The switch is controlled with Hark's Author! software package.

Circle (253) on Fast Fact Card

Microcell system uses existing hardware, software

SmartCELL is a compact microcell system that uses copper wire or T1 connections to provide improved cellular coverage in small, high-density areas. Compatible with existing network hardware and software, SmartCELL takes advantage of idle capacity. The system by **Decibel** can support as many as 64 single-channel base stations with one common controller at the cell site and one at the microcell, and from one to 64 microcell voice channel transceivers at the microcell.

Circle (254) on Fast Fact Card

Mobile sensor features 6-channel vehicle tracking, dead reckoning

The Placer GPS/DR is a 6-channel vehicle tracking sensor that uses Global Positioning System (GPS) satellite signals to provide accurate vehicle position. The **Trimble Navigation** unit uses a combination of GPS and dead reckoning (DR) technology and continuously calibrates the data input from the dead reckoning sensors to provide the position data. The sensor automatically switches to DR when GPS satellite signals are blocked by tall buildings, tunnels and parking garages.



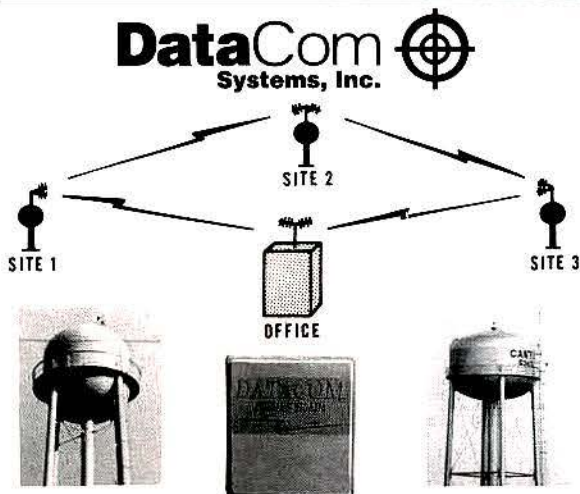
Circle (255) on Fast Fact Card

Connectors ensure minimum IMD levels

Andrew's $\frac{7}{16}$ DIN connectors are designed for high-power digital cellular communications systems where minimal intermodulation distortion (IMD) and low VSWR are a concern. Minimal IMD levels and high resistance to corrosion are ensured through silver plating on the connector body and inner contact pin. The connectors are designed for the foam dielectric and air dielectric coaxial cable.

Circle (256) on Fast Fact Card

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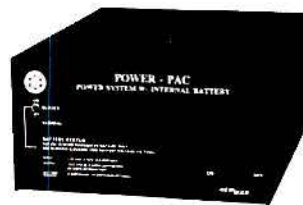
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Circle (257) on Fast Fact Card

Battery line includes Hotline series

Alexander Batteries offers replacement batteries for Ericsson GE's Hotline series. The batteries are 6.0V with a capacity of 1,200mAh, delivering as much as 120 minutes of talk time. The batteries are equipped with a charge reminder switch.

Circle (258) on Fast Fact Card

Software manages service center

Service Center Manager software is a customized, easy-to-use business management program for service departments. The program from Sencore is flexible enough for a one-person operation or a 20-employee service center.

Circle (259) on Fast Fact Card

Ear-Mike receives intrinsically safe rating

The EM-200IS Ear-Mike by Telex Communications has been listed as intrinsically safe by the Nationwide Consumer Testing Institute. The EM-200IS may be used in hazardous locations with system-approved radios. It is compatible with the following radios: Motorola MX-300, MT-1000, STX, P-200, MT-500, HT-600, GP-300, Saber; Kenwood TK-330; GE MPI; King LPQ; and Icom CH-18.



Circle (260) on Fast Fact Card

Mobile, portable radios feature PC field programmability



The Monogram series of mobile and portable radios from Ericsson GE handles all the basic two-way radio functions at an affordable price. The Monogram mobile is a 16-channel conventional radio in VHF and UHF frequencies with 40W transmit power, dual priority scan, PC field programmability, CTCSS and DCS. The Monogram portable features 5W or 1W power at a flick of a switch, PC field programming, 10 channels and channel-busy lockout.

Circle (261) on Fast Fact Card

Data radio provides high-speed transmission



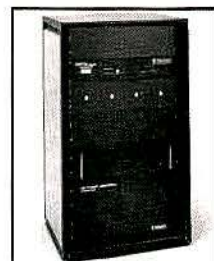
The FM 96 data radio from IWL Communications provides fast, reliable data transfer. It contains a UDS half-duplex wireless modem that transmits or receives synchronous or asynchronous

serial data at 9,600 bps over 450MHz-470MHz. Features include RS-232 interface and 2W UHF or 4W UHF. The unit measures 6.20"L x 2.10"W x 1.52"H.

Circle (262) on Fast Fact Card

Community repeaters offer 100W, 160W output

The LMR5 100W UHF and LMR6 160W VHF synthesized community repeaters feature panels that provide 10W, over-the-air or direct programming including tone enable and disable, airtime tallying for each tone, cross-tone and cross-code encoding, automatic Morse ID, prepaid airtime counter and airtime log. The repeaters from Standard Communications are housed in steel cabinets and have a modular design.



Circle (263) on Fast Fact Card

Keypad programs paging encoder

Model 15P is a desktop, manual paging encoder that may be equipped with as many as 14 analog and digital paging formats. The encoder from Zetron is programmable in the field from the keypad normally used for pager signaling. It is not necessary to return the unit to the manufacturer, to order new chips or to disassemble the unit to make programming changes. Simply enter codes on the keypad according to instructions in the manual. Pagers can be added any time, or a unit can be moved to a different paging system without assistance.



Circle (264) on Fast Fact Card

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- VHF, UHF, 900 MHz
- POCSAG signalling format
- Holds up to 16 messages
- 128 Character memory
- Selective message delete
- Uses one "AA" alkaline battery

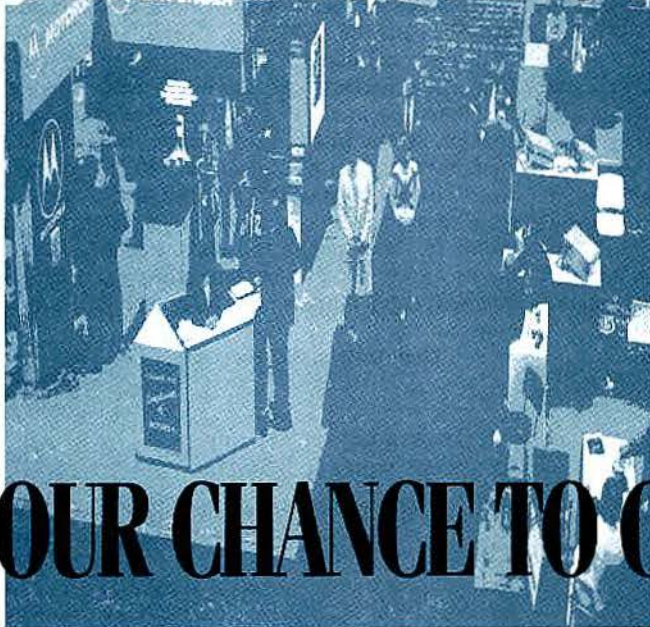


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Pager promotes user-friendly features

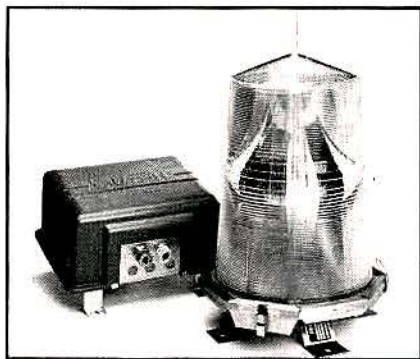
Motorola's FreeSpirit pager has a 12-character LCD, backlighting for easy reading in dark environments and top-mounting for easier viewing. All features are activated through a single button, making the unit easy to learn and use. If a message runs longer than 12 characters, it continues to a second line, providing a "second screen" to users. The FreeSpirit holds 10 8-character messages. A musical tone or gentle vibration indicates incoming calls.



Circle (265) on Fast Fact Card

Strobe beacon automatically flashes after a failure

The omni-directional Electro-Flash FTB 310 is a medium-intensity strobe beacon programmed to flash automatically after a red beacon failure. It has a small, lightweight power converter for facilities with minimum space and a dual-system interface for connecting two independent systems. The unit from Flash Technology is FAA approved.



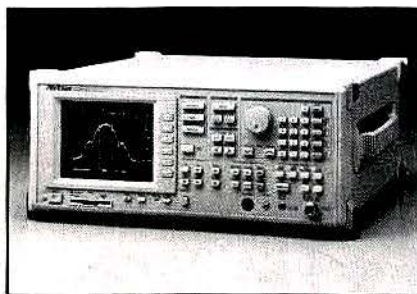
Circle (267) on Fast Fact Card

ULTRAc monitor, control system is compatible with modbus

The ULTRAc monitor and control system from Zetron is now compatible with the modbus protocol. This allows it to be incorporated into an existing SCADA system that normally makes use of wirelines to monitor and control remote equipment from a personal computer. The radio-based ULTRAc system can be added to existing SCADA system in a turnkey fashion. The equipment consists of as many as 240 remote terminal units (RTU) installed at remote sites. Each RTU is capable of monitoring 16 status points and eight analog inputs and is capable of controlling 16 open-collector outputs and four analog outputs.

Circle (266) on Fast Fact Card

Spectrum analyzer extends frequency range to 8.5GHz



The MS2602A spectrum analyzer features a high sweep rate and high resolution display, pretrigger function and an analog display for digital cellular radio measurements. The analyzer from Anritsu Wiltron has a frequency range of 100Hz to 8.5GHz and a level accuracy of ± 1.1 dB. Other features include AM-FM demodulation, auto tuning, signal search, zone sweep, 10 multiple markers, GPIB and an FM waveform display.

Circle (268) on Fast Fact Card

Tone remote adapters offer 4-, 10-channel selection functions

Model 836AA and 838AA tone remote adapters from SSC are designed to provide remote radio base station control via a dedicated 2- or 4-wire telephone line. The 836AA features tone-controlled relays for push-to-talk and monitor functions and to select four channels. The 838AA is an expanded version of the 836AA with 10 channel selections. Both units can be mounted in any 56-pin telephone industry standard enclosure.



Circle (269) on Fast Fact Card

Radiotelephone handset is voice-activated

The RTX-4620 Auduplex radiotelephone handset features on-hook dialing, last number redial, 10-number storage and recall, back-lit alphanumeric LCD, back-lit sealed keypad and volume control. The handset is voice-activated and controlled by a voice processing module.

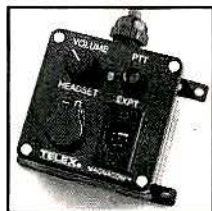


The RTX 4620 from RTX is designed to work with any RTX compatible controller.

Circle (270) on Fast Fact Card

Stand-alone station connects to fire truck radio

The MAG-PPR pump panel remote is a stand-alone weather-proof station designed to connect directly to a fire truck's radio. The MAG-PRI portable radio interface enables firefighters at the scene to monitor their portable radios without interruption. When the firefighter needs to leave the fire truck, the headset is unplugged from the vehicle intercom and plugged into the MAG-PRI, which is connected to a portable radio. Both units are additions to Telex's Magnacom modular emergency and utility vehicle intercom system.

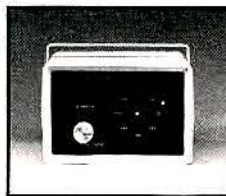


Circle (271) on Fast Fact Card

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For more information, call 1-206-771-2182.

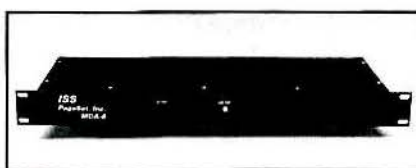


THE LEADER IN NARROWBAND TECHNOLOGY

New products

Satellite antenna distribution simplifies RF distribution

The MDA-8 multiple output distribution amplifier is a satellite antenna distribution system by PageSat. The MDA-8 is a 19-inch rack-mounted unit with one input and eight output 50Ω N connectors. The unit integrates into land mobile radio sites and simplifies RF distribution for paging and E-mail. Features include a built-in power supply, separate ac and dc fuses



and built-in power inverter to power outdoor electronics.

Circle (272) on Fast Fact Card

Software products turn PC into paging terminal

Paging Pro and Paging Pro LAN software products made by In-Focus Software allow users to send text messages to alphanumeric pagers using existing PC-compatible computer equipment. Paging Pro features an on-screen table of pagers, hot-key access while running other software, text editing in the message window and on-screen help. Paging Pro sends messages to single or multiple pagers. Paging Pro LAN is the local area network version that allows users of an entire office to send text messages.

Circle (273) on Fast Fact Card

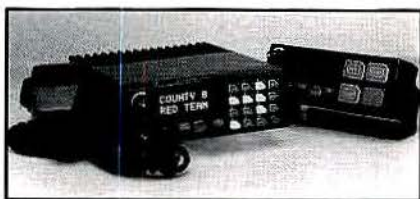
Pager uses NMH batteries

The CheckMate III pager from Falcon Direct has switch-selectable individual tone alerting or continuous monitor capability. Dual-frequency or dual-alerting capability is optional. A desk charger allows the pager to stay in the operating mode while charging. The CheckMate uses a nickel metal-hydride (NMH) battery with a longer operating life compared to a NiCd battery. A three-year guarantee is offered for both the battery and the pager.



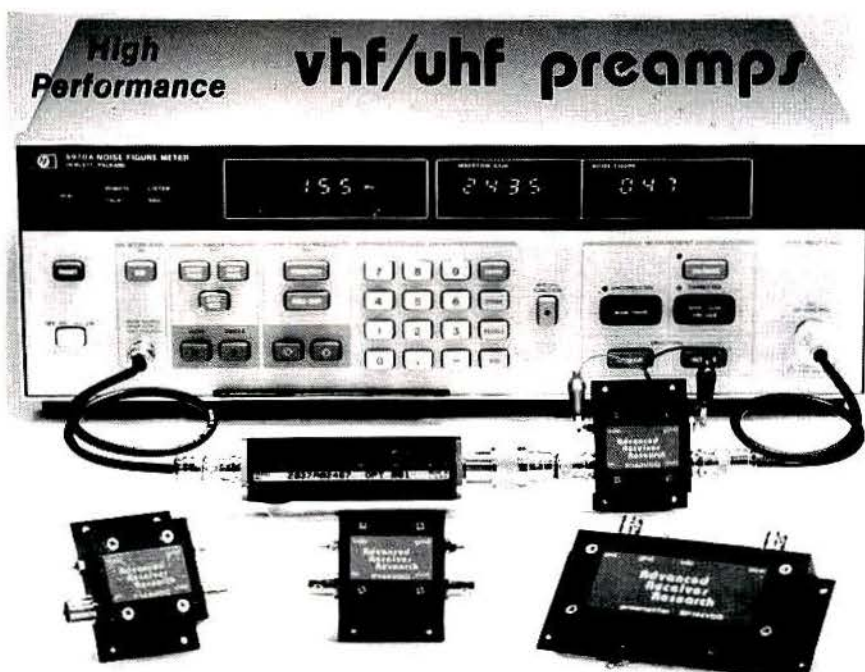
Circle (274) on Fast Fact Card

Mobile radio is ready for data



The Orion mobile radio works with either conventional or enhanced digital access communications system (EDACS) equipment in VHF and UHF bands. Standard features include wide-area and dual priority system scan, emergency alert, dynamic regrouping and individual unit disable. Data-ready technology allows the user to add external data, such as mobile data terminals, without adding components or even opening the radio. The Orion radio by Ericsson GE meets or exceeds Mil STD 810 C, D and E specifications for shock and vibration, rain, dust, salt, fog, humidity and temperature extremes.

Circle (275) on Fast Fact Card



Receive only	Freq. Ranges (MHz)	N.F. (dB)	Gain (dB)	Comp. (dBm)	Device Type	Price
P30VD, P36VD, P40VD, P45VD	30-35, 35-40, 40-45, 45-50	<1.3	15	0	DGFET	\$ 44.95
P30VDG, P35VDG, P40VDG, P45VDG	30-35, 35-40, 40-45, 45-50	<0.5	26	+12	GaAsFET	\$109.95
P150VD, P160VD, P170VD	150-160, 160-170, 170-180	<1.5	15	0	DGFET	\$ 44.95
P150VDA, P160VDA, P170VDA	150-160, 160-170, 170-180	<1.1	15	0	DGFET	\$ 56.95
P150VDG, P160VDG, P170VDG	150-160, 160-170, 170-180	<0.5	24	+12	GaAsFET	\$109.95
P450VD, P460VD	450-460, 460-470	<1.8	15	-20	Bipolar	\$ 49.95
P450VDA, P460VDA	450-460, 460-470	<1.2	16	-20	Bipolar	\$ 74.95
P450VDG, P460VDG	450-460, 460-470	<0.5	16	+12	GaAsFET	\$109.95
P800VDG, P830VDG, P860VDG	800-830, 830-860, 860-890	<0.6	19	+12	GaAsFET	\$119.95
Inline (rf switched)						
SP30VD, SP35VD, SP40VD, SP45VD	30-35, 35-40, 40-45, 45-50	<1.4	15	0	DGFET	\$ 74.95
SP30VDG, SP35VDG, SP40VDG, SP45VDG	30-35, 35-40, 40-45, 45-50	<0.55	26	+12	GaAsFET	\$139.95
SP150VD, SP160VD, SP170VD	150-160, 160-170, 170-180	<1.6	15	0	DGFET	\$ 74.95
SP150VDA, SP160VDA, SP170VDA	150-160, 160-170, 170-180	<1.2	15	0	DGFET	\$ 86.95
SP150VDG, SP160VDG, SP170VDG	150-160, 160-170, 170-180	<0.55	24	+12	GaAsFET	\$139.95
SP450VD, SP460VD	450-460, 460-470	<1.9	15	-20	Bipolar	\$ 79.95
SP450VDA, SP460VDA	450-460, 460-470	<1.3	16	-20	Bipolar	\$104.95
SP450VDG, SP460VDG	450-460, 460-470	<0.55	16	+12	GaAsFET	\$139.95

Every preamplifier is precision aligned on ARR's Hewlett Packard HP8970A/HP346A state-of-the-art noise figure meter. RX only preamplifiers are for receive applications only. Inline preamplifiers are rf switched (for use with transceivers) and handle 25 watts transmitter power. Mount inline preamplifiers between transceiver and power amplifier for high power applications. System S/N improvement 6-14 dB typical. Other amateur, commercial and special preamplifiers available in the 1-1000 MHz range. Please include \$2 shipping in U.S. and Canada. C.O.D. orders add \$2. Air mail to foreign countries add 10%. Order your ARR RX only or inline preamplifier today and start hearing like never before!

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Circle (66) on Fast Fact Card

Book explores ham radio

Beyond Line of Sight discusses how ham radio operators discovered and exploited many of the ways VHF radio signals travel. The **American Radio Relay League** book brings together a collection of articles.

Circle (300) on Fast Fact Card

Catalog describes remote control, signaling products

A catalog from **Solid-State Communications** features remote control and signaling products. Listed with each product description are purposes, features and applications. The catalog contains technical specifications and photos. A list of products in development and ordering information are included on the last page.

Circle (301) on Fast Fact Card

Catalog features antennas, accessories

A catalog detailing cable assemblies, antennas, mounts, connectors and accessories for land mobile and cellular markets is available from **JB Communications**. All products carry a limited lifetime warranty.

Circle (302) on Fast Fact Card

Catalog lists training materials

The 1993 "Wireless Communication Technology Resources" catalog presents a large selection of training materials and tools for the cellular, paging, wireless data and satellite communications industries. The color catalog from **Quantum Publishing** includes the latest books, directories, video tapes, audio tapes, engineering software, research studies and reports.

Circle (303) on Fast Fact Card

Comprehensive study covers mobile data service

The U.S. Mobile Data Marketplace: 1993 from **EMCI** offers a comprehensive study on mobile data service with specialized mobile radio (SMR), paging, cellular and satellite networks. The publication is based on interviews with telecom managers of companies with a high potential to

Flier discusses frequency-to-dc converter

A flier from **Solid State Electronics** describes the series 400KF solid state frequency-to-dc converter. The flier includes easy-to-understand diagrams, pertinent equations and information on electronic data, typical operation and mechanical data.

Circle (304) on Fast Fact Card

use mobile data services, as well as interviews with mobile data service providers, manufacturers, software developers and systems integrators. Comparative pricing and a coverage analysis for mobile data services are included.

Circle (305) on Fast Fact Card

Catalog discusses static dissipater technology

A detailed explanation of static dissipater technology and how it is used to prevent damaging lightning strikes is included in **Lightning Prevention Systems'**

catalog and literature package. The catalog also features a section listing new products.

Circle (306) on Fast Fact Card

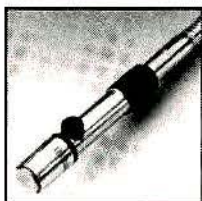


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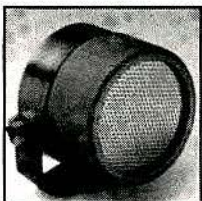


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Circle (68) on Fast Fact Card

F eedback

To use a consultant or not

Respondents to the August 1992 "What Do You Think?" questionnaire recommend the following suggestions when looking for a consultant:

- "Spend a lot of time looking and investigate prior performance personally."
- "Check credentials and qualifications of person assigned to your project."
- "Get references."
- "Look for experienced technician or field engineer, test them first, then hire for six months on contract."
- "Find consultants with field experience and knowledge and enthusiasm for the work."

Readers noted several advantages to hiring a consultant for a project including:

- "Gives an independent, impartial look at a problem or requirement."
- "Expertise."
- "Usually sound advice."

Disadvantages include:

- "Try to push line items that they get commissions on."
- "Our staff ends up doing all the work and sometimes spends more time on a project than would without consultant."
- "Not many (disadvantages) if consultant effectively uses tools at hand."
- "Resumes and experience generally lacking."
- "Expensive, not assured of good results before encountering expenses."



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Call Tina Rubin at 800-458-0479 or send her a FAX at
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Circle (71) on Fast Fact Card

Ronald R. Beaumont, President & CEO
MFS Telecom, Inc.
Ken Shulman, Vice President, Technology
Teleport Communications Group
Donald W. Grise, Director of Wireless
Interconnection, Bellcore
Peter O'Reilly, Department Manager-IN
Development, GTE Laboratories
Terry Hurley, Director-New Product
Development, Bell Atlantic
David Russell, Marketing Development
Manager, ADC Telecommunications
Beverly Lott, Director of Network Systems
Engineering, Pacific Bell
David Clark, Senior Manager of Switch
Product Planning, DSC Communications
Corp.
William L. Honig, Director of Network
Architecture & Standards, U S West
Advanced Technologies
Tom Raffaelli, Staff Director-AIN Planning,
Nynex
Carol Wilson, Editor, Telephony Magazine
John Young, Director, Intelligent Networks,
Bell Atlantic Network Services
Steven Parrish, Director, Platforms &
Services Development, Product
Development Marketing, Amertech
Services
Steve Titch, News Editor, Telephony
Magazine
James L. Zucco, Senior Vice President,
Advanced Network Technology, MCI
Richard Harrison, Director of Technical
Services, Bellcore
Bruce Johnson, Vice President, Operations
& Engineering, ITN
Robert Coackley, President, Telenex Corp.
Howard B. Wallace, Senior Consultant,
Arthur D. Little Inc.
Len Muscarella, Managing Director,
InterActive Media Associates
Jim Otterbeck, Gemini Consulting
Brian Whitton, Manager of Operations
Development, GTE Telephone Operations
Mike Fabish, Assistant V.P.-Residence and
Small Business Services, Bellcore
Elie Aklilian, Vice President, Marketing, INET
John Chiang, Director-Technology
Development, GTE Mobile
Communications
Alan Johns, Manager, Operations Supports
& Common Systems Technical Methods,
BellSouth
Nirmal Pujari, Director, Marketing-Product
Management, ITN
Gordon Quick, Vice President & General
Manager, GTE Telecommunication
Services
Ira Gorelick, Group Product Manager,
GTE Telecommunication Services
Steve McKenna, Technical Director,
Nynex Science & Technology
Richard L. Danzinger, Vice President &
General Manager-Wireline, TeleSciences
CO Systems
Ron Unglaub, Director of Internal Network
Management, GTE Telephone Operations
Glenn Ehley, Product Manager of AIN &
ISDN, Siemens Stromberg-Carlson

New officers at Radio Club of America (RCA) include:

Stuart F. Meyer, president. Meyer, who moves up from executive vice president, is a land mobile communications consultant in Vienna, VA, and an *MRT* editorial advisory board member. He succeeds **Fred M. Link**, who, after nearly 25 years as president, becomes president emeritus. Link is a communications consultant in Pittstown, NJ, and *MRT's* industry consultant.

Mal Gurian, executive vice president. Gurian, who moves up from vice president, is chairman of Globalink Communications, Irvine, CA. The Globalink post is new for Gurian, too, who moves there from a position as president of Universal Cellular, Anaheim, CA, as Globalink prepares to acquire patent rights from Universal for self-locating communications equipment that uses cellular telephone and radiopaging systems.

John W. Morrissey, P.E., vice president. Morrissey is a retired consulting engineer in Park Ridge, NJ.

Gilbert R. Houck, secretary. Houck is a consulting engineer, specializing in frequency control, in New Cumberland, PA.

C.T. "Tip" Foreman closes his company, Impact Marketing, Tulsa, OK, to join D H Marketing, Lago Vista, TX, as a manufacturers representative in the company's Tulsa office for Oklahoma and Arkansas.

David J. Dunlap, manager of quality control for Hanover Park, IL-based Maxrad, advances to vice president of engineering.

Dee Robison, graduate of Colorado State University with a degree in business administration and a concentration in marketing, becomes manager of software inventory and product delivery with SoftWright, Denver.

Changes at NovAtel Carcom, Fort Worth, TX:

Richard Leicht, leaves Lin Broadcasting, New York, as vice president of national operations to become vice president of sales and marketing for NovAtel Carcom.

Bhanu Bhattasali departs CalComp, Anaheim, CA, as strategic planning director to join NovAtel Carcom as vice president of strategic marketing.

Michael Verneti leaves Telocator, Washington, DC, as senior vice president to join Kaufman Public Relations, Washington, DC, as senior vice president.

Robert W. (Bob) Fisher exits Schaffer Communications, Houston, as an engineer to become general manager and telecommunications engineering consultant with Spectrum Engineering, Houston.

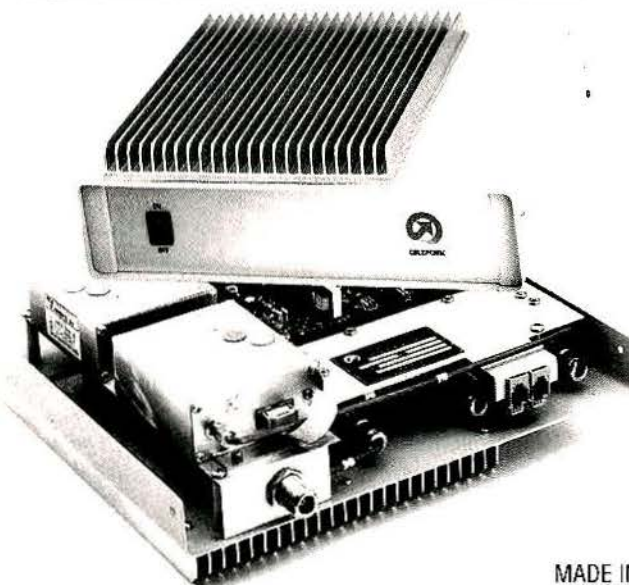
Joe Vaughan departs Johnson Radio Communications, Minneapolis, as a sales and marketing representative to join Telex Communications, Minneapolis, as domestic sales manager for land mobile radio products.

E. Stephen T. Towns-end joins Powerphone, Madison, CT, as director of training, research and development. He is also a lieutenant with the Lake County, IL, Sheriff Department.

Christine Spisto leaves Environmental Solutions, Irvine, CA, as marketing, communications and public relations manager, to become marketing communications and public relations specialist for Standard Communications, Los Angeles.

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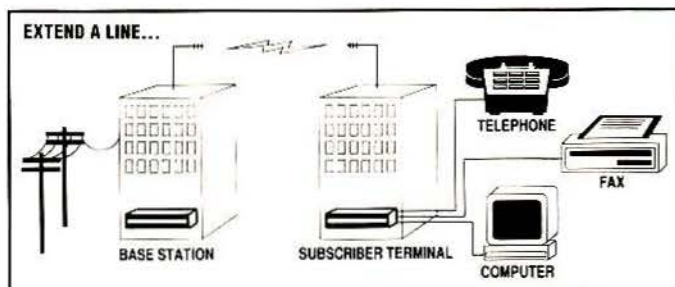
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Circle (72) on Fast Fact Card

The last technician:

As I close the door for the last time, I stop to glance around. It had been an interesting career, but now it was gone.

Like many people, I believed the work would go on forever. Things were changing so fast that no one seemed to see what was coming.

It was like a steam roller going down a hill. Only after it rolls over you do you realize what happened.

I still remember when I started in the two-way radio field in 1963. All the radios were trunk-mounted with lots of tubes to keep your car warm.

You could fix any radio because all the manufacturers used the same parts. To see a multichannel radio was a rarity. The use of CTCSS was just starting, and there were still a few single-tone radios around.

Those were the good days of two-way radio. You had to order radios on a particular frequency and tone, then wait for it and the license to arrive about two months later, hoping all the time that some other radio dealer hadn't sold your customer another radio at a lower price. There were no instant radios or instant licensing then.

Repairing radios only took a well-stocked tube caddy and a stock of vibrators. All you had to do was to change tubes until the radio worked and then align a lot of coils and capacitors.

I remember setting frequency then, too: with the Gertsch FM-7 you had to make nine adjustments to generate a particular

frequency, after it warmed up for an hour.

But radios changed.

Along came transistorized radios, the Motorola Motrac and Motran and the GE Mastr.

Then there were those portables kindly referred to as *bricks*, the Motorola HT200 and the GE PR. What engineering wonders!

Although the new radios were more efficient and ran cooler, they still were trunk-mounted. Repair was fairly easy. Parts from one were similar to parts from another.

The parts box had fewer and fewer tubes and more transistors and low-voltage capacitors. Now you could just dial in a frequency you wanted if it was in the frequency band that your instrument could generate, such as the Gertsch FM-9 and Cushman CE-3.

Finally, tubes were gone for good.

The GE MastrII and Motorola Micor were here. And some strange names were appearing, names such as Standard, Midland and Kenwood.

The '80s were here, along with instant licensing and another new idea, *trunking*.

The radios were getting more and more complicated and harder and harder to fix. "What ever happened to push-to-talk, volume and squelch?" commented technicians.

These new radios required more specialized test equipment, and they had more and more specialized components not

How to write for Mobile Radio Technology

We want to publish your article about two-way radio dispatch, paging and mobile telephone communications involving equipment and systems design, installation, operation and maintenance. Accessories and support equipment and services are included, too, such as power sources and microwave relays. Topics from other related fields may be covered from time to time.

Writers' rewards

What often motivates authors includes:

- increased visibility that may lead to advancement within their companies.
- improved company image by demonstrating technical competence and capabilities.
- product awareness, especially for technology and functions beyond what might be revealed by advertising.

Experience makes good articles

Technicians and engineers who have solved a particular problem or who have developed a new technology or technique are well equipped to tell a story that would interest our readers. Usually, the more practical the idea or method, the better the article.

Although the explanations of the latest developments make good articles, so do tutorials that explain basic subjects. Reviews of digital signal processing, microwave system design and software have proven popular, for example. "Big" subjects can be handled with a series of articles. "How-to" descriptions are well received.

Editorial assistance

Some articles arrive ready to be published. If an article is not quite ready for publication, our editors can make the necessary modifications, sometimes requiring only a telephone conversation with the author. If for some reason an article must be returned, suggestions are included for revisions that would make it ready to publish. A set of guidelines for writing is available for the asking.

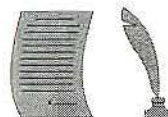
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Color photos are considered for use on the cover; slides and transparencies work best as cover illustrations. Otherwise, photos may be submitted as slides, transparencies or prints. If you would like to submit a picture as a possible cover illustration, we recommend you talk with an editor to increase your chances of obtaining a usable photo on the first try.

We have editors who love to help people prepare articles for the magazine. If you are undecided whether your topic might be suitable or if you need help at any stage in the writing process, please call. We would love to hear from you.


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Letters to the editor

found in other radios. Shops only serviced the brands they sold. Then came something that would change two-way radio forever: cellular telephones.

Not everyone jumped onto the cellular bandwagon. Some who did made money at first, but the real money was made by the licensee.

There were supposed to be two systems in every large city, one wireline and one non-wireline, but soon the wireline carrier was owned by the local phone company, and the non-wireline carrier was owned by a distant phone company. The phone companies had discovered there was a lot of money in two-way radio.

That was the start of the great frequency grab and the beginning of the end of the two-way radio business, as well as other unsuspecting businesses. If only we had known and bought stock in the phone companies then.

The takeover was happening faster and faster. It was like walking down a tunnel and seeing a light, not realizing it was the headlight of an approaching locomotive.

First the phone companies took over the cellular phone business, all of it. Then the paging companies fell one by one. Cheap voice mail was the end to answering services and machines.

Then came spectrum auctions!

Wait a minute—I thought the people owned the airwaves. Refarming below 470MHz—I could not keep up! Buy a frequency for customers? I could not pay for airtime on their systems.

There was ESMR, a pseudo-cellular system that the phone companies bought as soon as it was put into operation. SMRs, one by one, fell to the system. Any new system always was owned by the big-brother personal communications network (PCN).

The equipment was more complicated than ever, as complicated as the systems they worked in.

By 1996, radios were non-repairable. You could not even get a service manual. If the battery was OK, then send it in for repair.

All radios had five-year factory parts and labor warranties. Everyone was selling them like cellular telephones and pagers were sold. PCNs and business communications networks (BCNs) were hot items.

Today is Dec. 31, 1999—tomorrow a new century and the end of available frequencies. The last open frequencies, 154.570MHz and 154.600MHz, will be closed forever because the phone company plans to use them for a kid-finder system.

Well, we came a long way from where anybody could get a free license simply by applying. At one time there were the

coordinators who charged two-to-10 times the license fee just to let you apply. (They are gone, too.)

At the turn of the century, one company controls all the frequencies except broadcast, CB and amateur, all under the guise of spectrum efficiency; no mention is made of the money the government receives for its user fees.

Every radio has an ID and works in some sort of cellular system. Yes, the phone company does have your number and knows where you are within 50 feet, if you carry a phone.

Well, as I close the shop for the last time, I glance across the street where the old cable TV company used to be, and next to it, Fred's Alarm Company. They closed a few years ago when the phone company put in fiber optic cable to each home.

There used to be computer services, but the phone company does that now, as well as delivering electronic newspapers. The post office only makes special deliveries. The rest is on fiber optic home fax.

Big brother is watching as the new interior and exterior TV cameras in the phone company's fiber optic home alarm system provide the ultimate in security—and invasion of privacy.

So, I am closing the shop for the last time, the last two-way radio shop in the world.

There is nothing to fix.

I'll go home and turn off the phone company's alarm system, turn on the fiber-optic cable TV system and check the home fax for mail. I'll call the PCN master control to get a printout showing where my kids have been today.

Yes, I'll go home—as soon as I get clearance from the Federal Air Quality Management people to drive my car.

Rod Wheeler
The Radio Shop
Diamond Bar, CA

The two toughest problems facing me on the job are:

- users who do not (or will not) understand FAA restrictions on radio operations at airports.
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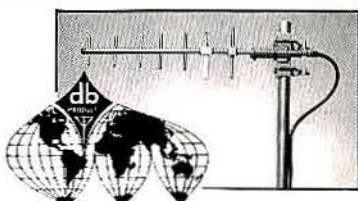
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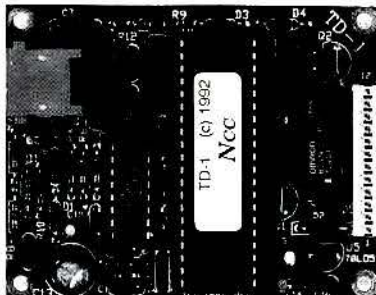
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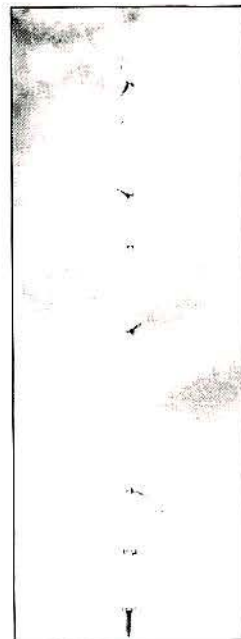
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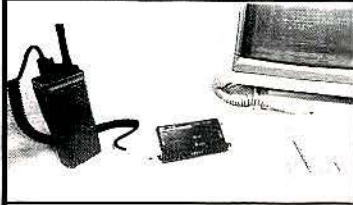
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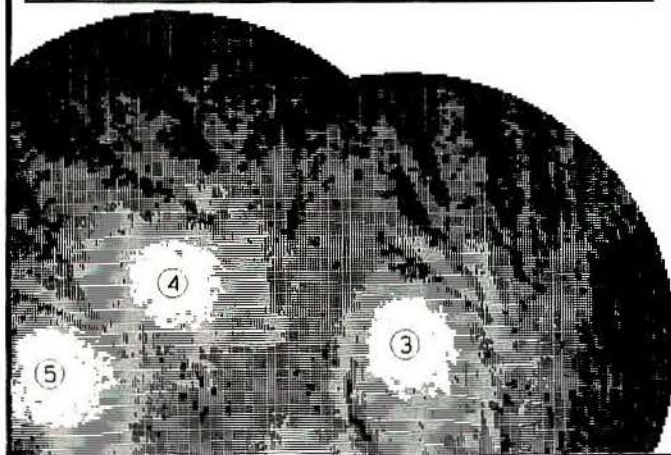
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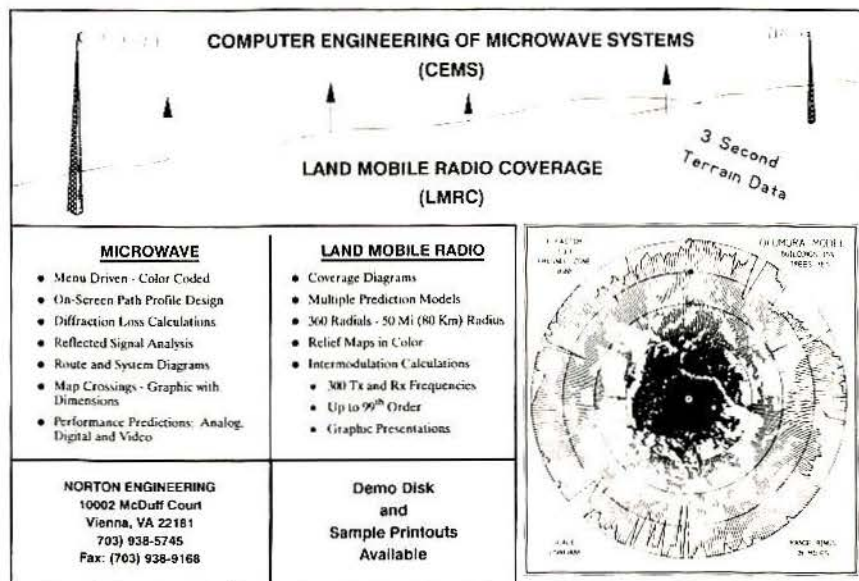


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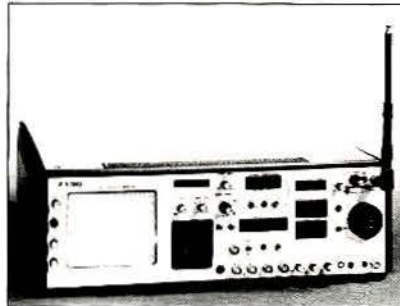
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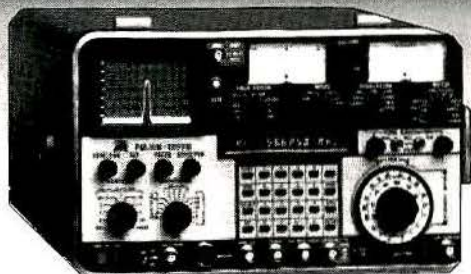
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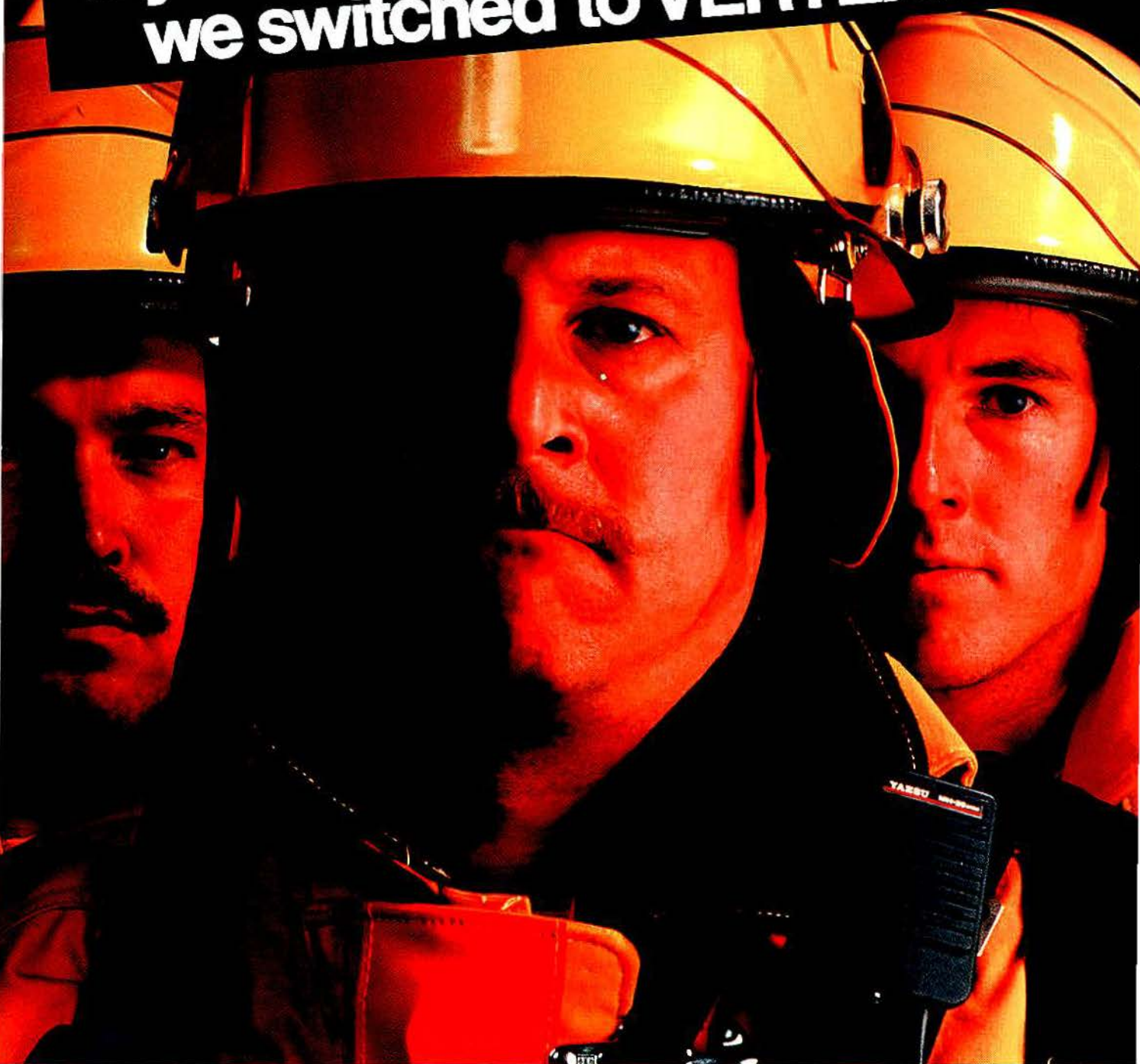
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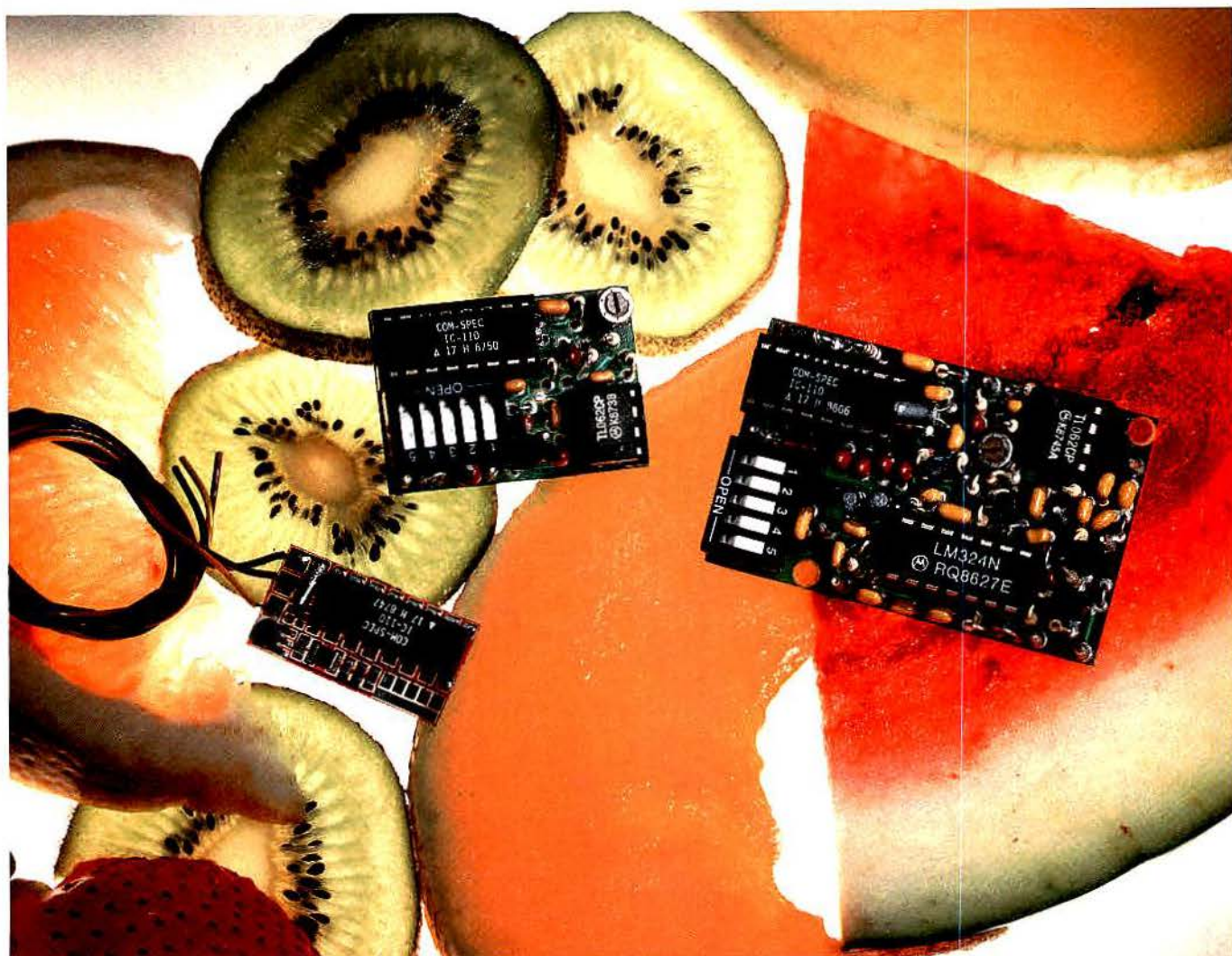


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